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THE AMERICAN PATENT SYSTEM.

The thoughtful article by Mr. Philip Mauro in another column clearly points out certain defects in the American patent system, which have been keenly felt by many inventors in the electrical field. The facts that a United States patent has long ceased to be a guarantee of protection to the inventor and that the value of a patent can only be ascertained after it has been in litigation are well recognized. For many years there has been a slow but steady deterioration in the quality of the protection given by a patent, which has come to be now hardly more than a registration of the invention whose value remains to be tested by tedious and often very expensive processes in various courts. Nothwithstanding this the Patent Office has continued to work upon the assumption that every application acted upon receives careful comparison with all existing patents and publications in its class, and that its novelty and validity are assured by its issue. Mr. Mauro proposes, by way of reform, the substitution for this burdensome system of something similar to the practice of the English Patent Office, in which inventions of any kind can be patented, the subsequent validity of these patents to be assured by the courts. This, however, is no great departure from the present method in vogue in this country, except that under it an inventor would definitely know what he might expect and feel no false sense of security on account of the issuance to him of a patent.

There is another side to this question, however, which is the unquestioned fact that a proper administration of the system supposed to cover the grant of American patents would result in giving character and value to each patent issued from the office. There is no question that, with a proper expenditure of money for the purpose, this full and authoritative review of each application can be had. As Mr. Mauro points out, the Patent Office is a money-making institution. The fees which have been paid in by patentees have accumulated in excess of the expenditures of the office, and a large sum now stands in the Treasury to the credit of that institution. Of course this is not available without direct appropriation by Congress, and it is generally felt that this appropriation will be very difficult to obtain. If, then, the only solution is the freeing of the office and the granting of patents upon applications without any assurance whatever of their validity, it would seem well to incorporate a feature of the German system which requires the inventor to show, not the novelty of his device, but its practical utility. As only about one patent in fifty has any commercial value to-day, any plan that would result in the restriction of the number of patents issued and in the weeding out of the worthless ones would be of great utility. There can be no doubt that the time is near at hand for reform in the American patent system, and Mr. Mauro's suggestions are both timely and interesting.

THE DIELECTRIC STRENGTH OF OILS.

The results of the observations made by Messrs. Northrup and Pierce upon the dielectric strength of oils, and published in another column, exhibit some peculiarities of the effects of the various sorts of high-potential currents upon oil and air insulation, which are, to say the least, curious. A number of measurements in which the breakdown strength of oil and air gaps was compared, the sources of current being a high-frequency coil, an induction coil with a hammer break and the same coil used as a transformer and probably giving an approximate sine-wave current, showed the remarkable fact that oils seem less able to resist the sine-wave current at high potentials

than the much more irregular currents due to the other generating apparatus. At least, as the comparisons stand, this seems to be indicated, but the result may mean that air is less able to endure the strain of the high frequency and induction-coil currents than the more regular sine-wave current. Certainly the conclusions are very remarkable. It appears that kerosene oil has valuable qualities as an insulator for various forms of high-potential currents. The ratio between the break-down strength of certain oils and air seems to increase with the increase of potential. The authors point out that while under high transformer potentials the insulating strength of certain of the oils is not greater than that of air, yet their use is advisable, especially in condensers, since surfaces immersed in oil are not so liable to form a conducting path for a discharge as when exposed to the atmosphere, especially if they are of a hygroscopic nature.

There is no subject more worthy the attention of experimentalists and electricians at the present time than that of insulation methods. The rapid increase in the number of high-potential transmission plants, and the growing importance of the uses to which currents of very great potential are being put renders it necessary to study the subject of insulation for these high pressures closely and thoroughly. The problems of line insulation seem to be very well solved by the use of various forms of porcelain and combination porcelain and oil insulators. The insulation of transformers, condensers and coils for dynamo and motor machinery has not yet reached the high plane of efficiency which seems desirable, and further knowledge along these lines would be highly valuable to many engaged in power transmission and other similar work. There seems to be a tendency to increase the range of action of power-transmission plants by the employment of higher and higher potentials, and the study of insulation is a fundamental necessity before much longer distances or much higher working pressures can well be attempted.

A MODERN OFFICE BUILDING.

The structures which are rising in our large cities for office and commercial purposes are rapidly becoming more and more complex. They now include within their limits the various functions of distribution of water, heat, light, power and intelligence, together with means of transit, which in former times were confined to municipalities. The Commercial Cable Building, a fine example of this kind of structure, is described in this number of The Electrical World, and the part which electricity plays in its economy is interestingly set forth.

In the light of recent progress it almost seems that without electricity these structures would be impossible. In the example cited, electricity does the work of lighting, of transit from story to story, of ventilating, of transmitting intelligence, of supplying power for the manifold purposes for which it is used by the host of tenants, and finally the building is heated by the exhaust steam from the engines used for generating the electric current.

The feature which is most prominent in this fine installation is the use of storage batteries for the regulation of the load and the surprising facility of combination and regulation given to the plant by the addition of these accumulators. The method of connecting the booster, the dynamo and batteries together results in a satisfactory and somewhat novel combination which promises to prove highly useful in practice. Without some such system as this it is hardly likely that the elevators and lighting circuits could be driven from the same bus bars with perfect satisfaction, although the regulation of both engines and dynamos seems to be well nigh perfect. The use of 220-volt lamps throughout the building simplifies the system of wiring considerably, and marks another step in the progress of this type of lamp toward its general utilization.

LIMITATIONS OF THE ELECTRIC CAR.

The serious inroads which electric-traction systems have made on the business of railroads between centres of population and their suburbs have caused some curious attempts to imitate, in one way or another, on the steam system, the conditions of the electric road. The latest of these attempts is the construction of what is called a steam-motor car for the New York & New England Railroad. This steam-motor car, which is practically a revival of the old-fashioned steam dummy, consists of a 64-foot car body, mounted on two trucks, one of which carries the driving mechanism. In the car over this truck there is a small vertical boiler, and on the truck are mounted two cylinders, with appropriate connecting and parallel rods. The idea is to obtain a short train without excessive dead load, and one which can be run with a crew of two men. With such a car it is obvious that more frequent service can be given than with regular locomotive-hauled trains for which the ordinary traffic does not justify frequent running.

Years ago attempts were made with what were known as "steam dummy" cars to reduce the expenses of suburban service, but apparently without success, as they were soon abandoned for the regular trains. Unless conditions have changed in the relative economy of these cars and complete trains more than is apparent, these new steam-motor cars will probably be less successful in competition with the trolley than is the locomotive. The only advantage they have in common with the trolley over the locomotive is the opportunity for more frequent service. The greater convenience of the trolley car, its ability to carry passengers within easy walking distance of any point by the help of transfers, and its freedom from smoke and steam are advantages not attained by the steam-motor car. The suburban railroads, after many costly experiments, will probably find that the real solution of the competition in this field, as in many others, is in combination. The two systems are admirably adapted to work together, either by a system of transfers or by the operation of through cars at high speed over the private rights of way and at low speed over the public streets.

An interesting case of this combination, at Wilkesbarre, Pa., is described in another column. Here, in spite of the obvious disadvantage that the traction on the private right of way is obtained from steam-power with the motors idle, the system gives great satisfaction and pleasing financial results.

What's in a Name.

In a recent number of the London *Electrician* the following reference is made to a new motor car: "A Petro-Electric Automobile is the name given by *L'Industrie Electrique* to a motor car on the Heilmann principle, now being constructed at the Heilmann Works. The carriage is to have twelve seats, and will be provided with a 16-hp petroleum motor, driving a dynamo which will work a motor connected by gearing to the driving wheels. We shudder to think what would be the correct German designation of this atrocity. In plain English it would be called—a fad."

Postponement of the New York Electrical Society Meeting.

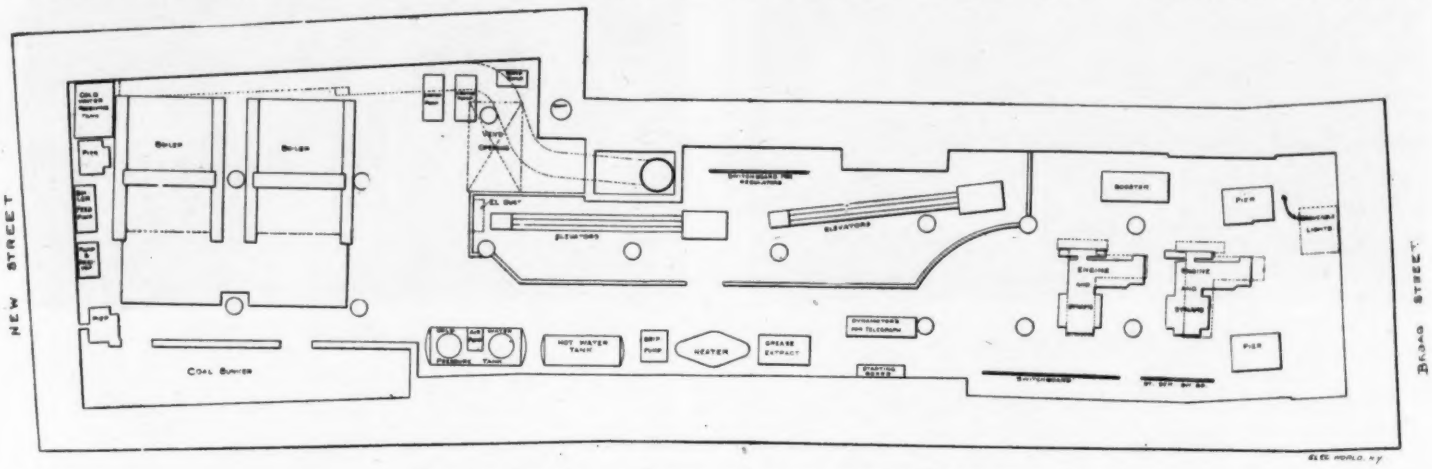
The meeting of the New York Electrical Society, which was announced for Monday evening, November 8, at the Columbia University Buildings, has been postponed, owing to the fact that the lighting system of the new Columbia grounds will not be ready for operation at that time. Further notice will be given of the date of the meeting.

The Electric Plant of the Commercial Cable Building.

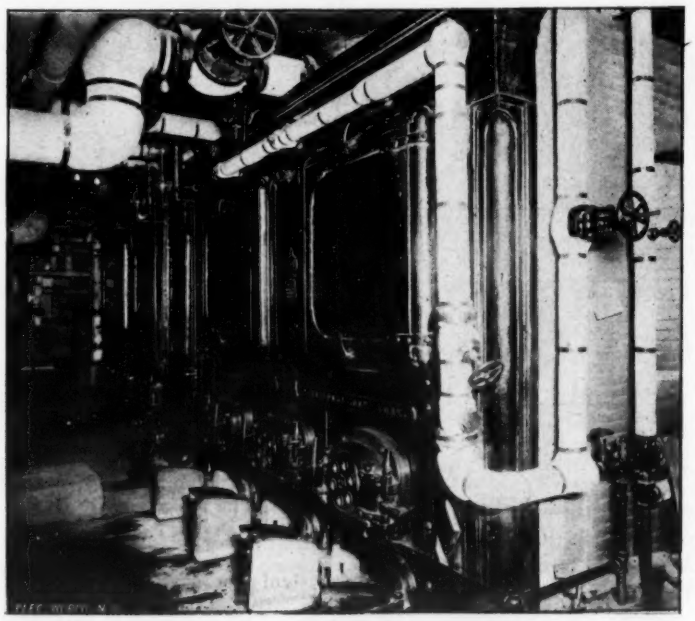
IN the business centre of New York City immediately adjoining the Stock Exchange, the Commercial Cable Company has built for itself a new home. The building, as the plan shows, is a long, narrow structure running through from Broad Street to New Street, its dimensions being approximately 180 x 50 feet. Like all modern buildings in the crowded business districts, it is of the steel frame construction, founded on caissons, and carried up to a great height, in this case twenty-one stories exclusive of the two domes. The electrical equipment of the building is very complete. In fact, every useful service that could be performed by electricity has been adopted there.

Below the street level there are two floors, the lower one of which is given up entirely to the steam and electrical equipment. In the New Street end of this floor are two 309-hp triple-drum Babcock & Wilcox water-tube boilers. Beside them and under the New Street sidewalk is a large coal bin. Down the central part of the building on this floor are arranged the various boiler-feed, drip, bilge and water-service pumps, grease extractors, feed-water heaters, pressure tanks, etc., necessary to supply the various needs of such a building. In the Broad Street end is placed the electrical generating plant. This consists fundamentally of two direct-connected units. The engines are of the Harrisburg Ideal make, single cylinder, 16 inches diameter by 17-inch stroke. They run at 220 revolutions per minute, with 100 pounds steam pressure, giving 225 horse-power each at one-quarter cut off. They are direct-connected to Siemens & Halske six-pole generators of the outside-armature type. These armatures are 6 feet in diameter, and, with a 5,000-pound fly-wheel on the other end of the shaft, give a high moment of inertia to carry smoothly over any sudden peaks of the load curve. The dynamo and engine combination is very compact, the whole shaft being made in one piece to minimize space. The unit is mounted on a cast-iron base, which is placed directly on the floor of the engine room. This floor consists of a concrete and steel I beam construction bridging the spaces between the caissons. In spite of the apparent lack of solidity of such a foundation, the units run with remarkable smoothness, there being no vibration whatever transmitted to the floor. The dynamos are compound wound for constant potential of 240 volts, and the ability of the combination to hold a steady voltage on the very variable load is remarkable. With a lighting load of 100 amperes, and a motor load varying from zero to 600 amperes, the maximum instantaneous change of voltage is less than 3 per cent. with one engine in service. Even this slight variation will be eliminated as soon as the storage battery plant is put in service.

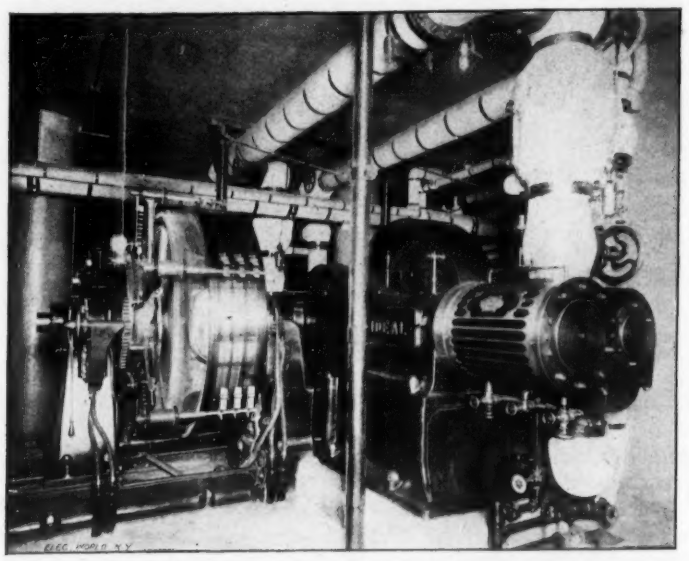
The switchboard equipment is probably the most elaborate and thoroughly worked out of any ever constructed in an isolated plant. In the centre of the main board is a large panel carrying all the generator controlling and measuring devices. The usual circuit breakers, main switches, voltmeters, ammeters, steam and exhaust gauges, recording thermometer and voltmeter, rheostats, etc., are provided. The board is equipped with several independent sets of very heavy bus bars, measuring 3 inches by one-half inch in cross section. One set is for lighting purposes, another for power, still others being provided for breakdown service on the Edison street mains. Each dynamo is provided with two main double-throw, triple-pole switches, the clips of the middle pole being removed on one side, With these either dynamo may be worked as a shunt or compound



PLAN OF SUB-CELLAR SHOWING ARRANGEMENT OF MACHINERY.



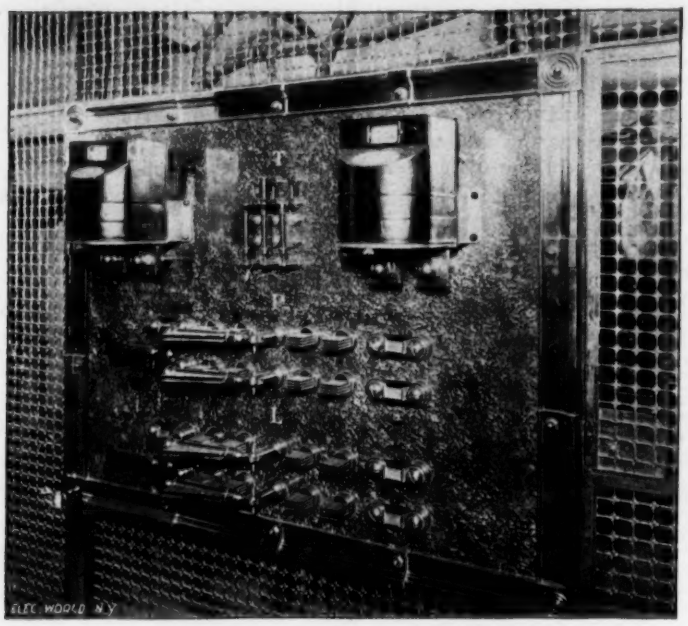
TRIPLE DRUM BOILERS.



ONE OF THE GENERATING UNITS.

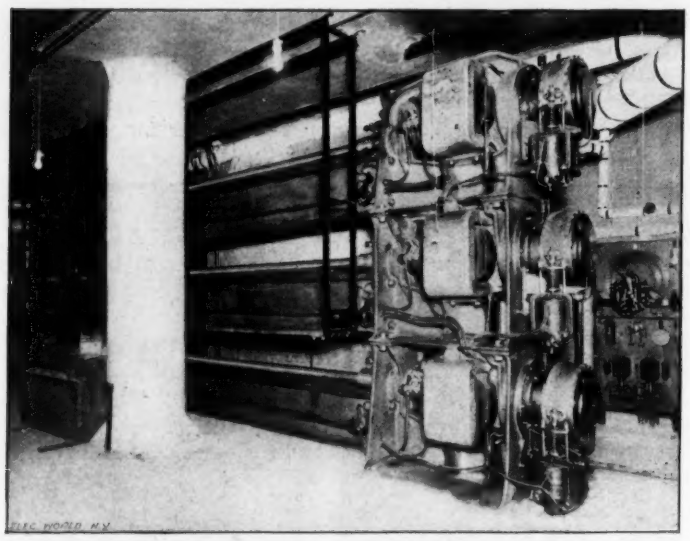
machine, singly or in multiple with its fellow on the lighting or the power circuit, or both together. The lighting buses feed twenty-five feeders to the twenty-five different floors, each feeder being provided with a magnetic circuit breaker and a double-pole, double-throw switch, by which it can be thrown either on the lighting buses of the isolated plant or on the buses fed from the breakdown service of the street system.

A short distance from the main switchboard is an auxiliary switchboard controlling the main circuits of the breakdown system. As the whole building is run on 240 volts the neutral wire is not needed,



Street Service Switchboard.

the positive and negative only being brought through the switchboard. Leads are brought in from both the Broad Street and the New Street mains of the Edison system, and are led to double-throw switches on the breakdown board. By means of these either the lighting or the power load of the building, or both, may be thrown

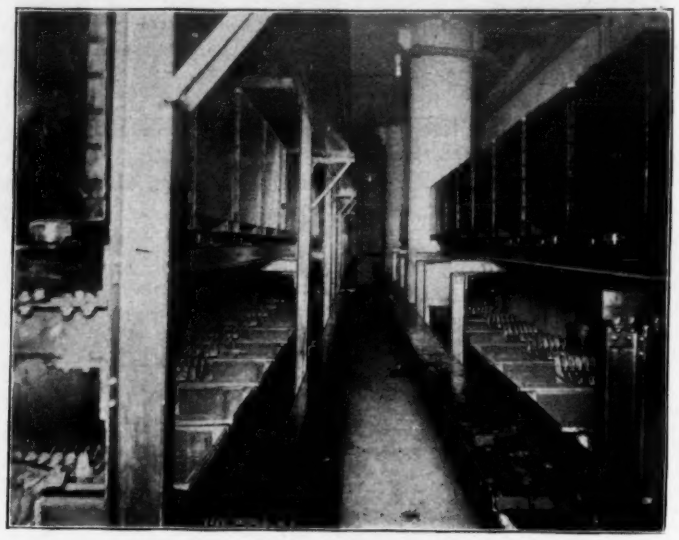


Triple-Deck Electric Elevators.

on either the Broad Street or the New Street mains of the Edison system, or on both in parallel.

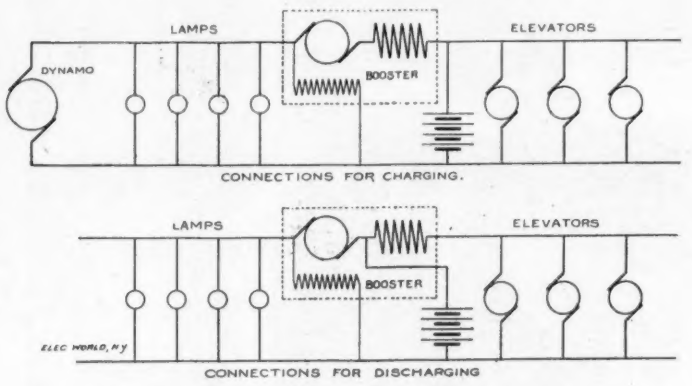
The most remarkably flexible part of the whole system, however, is the arrangement of the storage battery and booster switchboard. The battery consists of 120 cells of chloride accumulators, the internal dimensions of the cells being 20½ x 26½ x 20¾ inches. The boxes are made of ash, lined with lead and painted with asphaltum paint. They are mounted on glass insulators, shimmed up with hardwood blocks on 4-inch I beam frames. To economize space, the batteries are arranged three tiers high on one side of the room, and two tiers high on the other. Strong running boards are bracketed out from the frames for the use of attendants. All the steel work is dipped in lead to protect it from the fumes of the battery. All riveted joints were dipped after riveting, and all bolts were separately dipped. The battery is to have eventually a capacity of 2500-ampere hours. At present, however, only part of the plates are being installed, sufficient to give 800 ampere hours. The plates in the batteries rest on glass strips, which in turn rest on lead legs. All copper leads and jumpers in the battery room are dipped in lead. The connections between adjacent batteries are made by burning the plates to lead bus bars. The battery room is ventilated by a 24-inch exhaust fan, driven by a one-half horse-power Lundell motor.

The battery currents are controlled by a 25-hp booster, consisting of a General Electric 240-volt motor driving, at 1300 revolutions,



Storage Battery Plant.

a General Electric 75-volt, 250-ampere generator. The two machines are coupled to each other with an intermediate bearing between the two armatures, and are mounted on one base. The field of the booster is wound with a series and a shunt coil, the combinations of which, with the various loads, are highly interesting. During the day the battery is charged, the connections of the booster fields being as shown in the diagram, the series field working against the shunt field. In this case, if the elevators take a heavy current, the booster weakens, which prevents the heavy current being pulled from the dynamo, and throws it all on the battery. At night the connections are changed to those shown in the lower part of the diagram,



Connections for Charging and Discharging.

and the dynamo is removed. In this case, the connections of the fields are such that they work cumulatively, and if the elevators draw a heavy current the series field builds up the booster voltage to compensate for the drop in the storage battery, maintaining the pressure across the lamps constant. The switchboard equipment is so complete that various other emergency combinations can be made of the batteries and boosters, but the two combinations shown are the regular running systems. Circuit breakers are provided for the storage battery and the booster motor, as well as an under-load breaker for the battery. A novel starting arrangement for the booster motor

is also used, consisting of an under-voltage and overload circuit-breaker switch, with a starting rheostat so arranged that the switch cannot be closed unless the rheostat is all in.

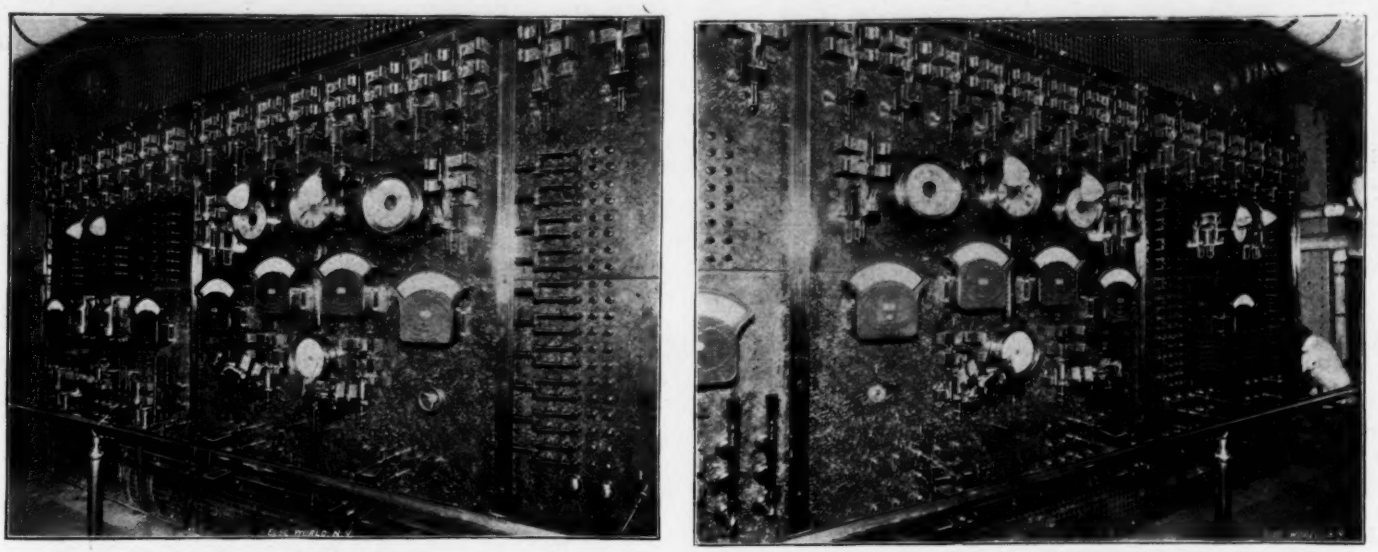
The elevator system of the building comprises six Sprague screw machines and one Sprague ash hoist. The screw machines are arranged in two triple-deck tiers. The machines are immediately under the shafts in the central part of the building, and their six controlling panels immediately beside them. The compactness of the whole installation of six elevators can be appreciated by a glance at the plan. The control is of the regular Sprague pilot-motor type, the car being under-counterweighted to such an extent that it comes down by gravity, the hoisting motor working as a dynamo on a dead resistance in the descent. The motors are 30 horse-power each at 275 revolutions. The screw machines are 33 feet long over all, with sheaves on the cross heads, giving a multiplication of 8 to 1 and a further multiplication of 2 to 1 in the shaft overhead. The elevators run at about 600 feet to the minute, the height of the lift being approximately 200 feet.

Many novel features are embodied in the electric light wiring and fitting. Each of the main feeder lines consists of two insulated, iron-armored interior conduits, each side of the two-wire circuit being run in a separate pipe. At each floor in the wire shaft the feeder pipes enter an iron branch-main box, where the feeder wires are connected to a double-branch fusible cut-out. The two mains for each floor from this point are run in iron-armored conduit to panel boards, two on each floor, from which duplex wire branch circuits extend to the outlets in single, insulated, iron-armored pipe. Okonite wire has been used throughout for the lighting leads.

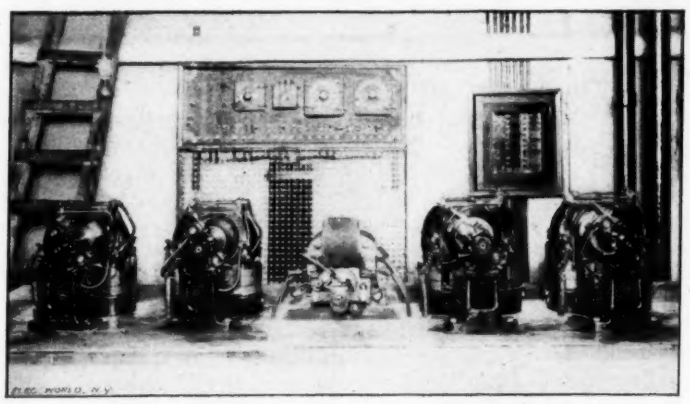
As special care was necessary in dealing with double the usual lamp potential, several new arrangements of panels, outlet boxes and fixture connections have been adopted. The panel boxes are of particular interest. These consist of rectangular iron box frames set in the plaster wall, so that they may be reached from either the front or the rear. Centrally placed in these iron boxes is a slate panel board, on the face of which the panel bus bars and branch-circuit switchblocks are set. Each of the branch circuits is controlled by a removable fused switch holder, combining the function of a knife switch and a fuse cut-out. Connections from the clips and bus bars are brought through to the rear of the panel board for connection to the various wires. This arrangement is unique, inasmuch as it permits of any change in the connections or arrangement of the conductors with the greatest ease.

The panels on each floor feed the base outlets on that floor and the ceiling outlets on the floor below. There are about 3,000 16-cp lamps throughout the building. All the chandelier lights are controlled by switches set in the balls of the fixtures and easily accessible from the floor. The distribution of base outlet boxes for plugs has been very liberal, it being assumed that the use of removable and portable light fixtures is desirable in a building of this kind. These outlet boxes are equipped with fused porcelain attachment plugs. In the connections of the fixtures no bug cutouts have been used, the fixture wires being directly soldered to the outlets. The methods of supporting these boxes and fixtures is novel, and is shown in the illustration. Each ceiling outlet box is held in position by a star anchor-holding bolt projecting through the fire-brick arch. The tubes and wires enter from above the arch, and on the finished ceiling is a circular, hard-wood block, which is screwed to the iron outlet box. The fixture is supported by a crow foot from this block, which takes the place of an insulating joint. No gas is used in the building, except in some of the hall fixtures.

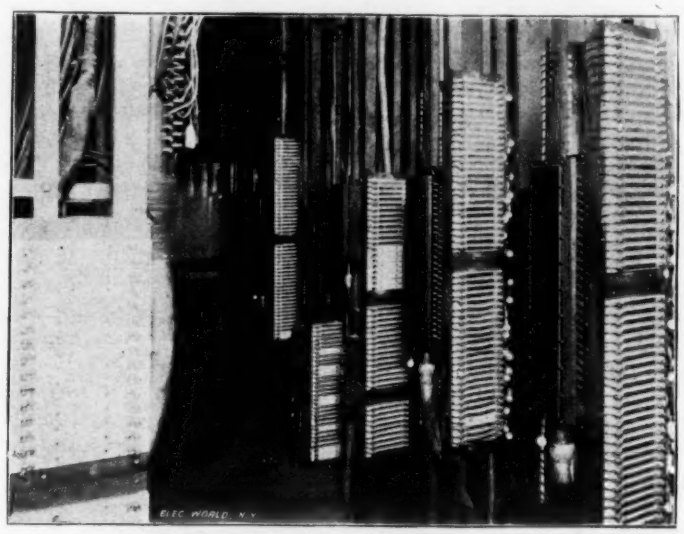
A most complete arrangement has been made for the various signal, telephone, ticker and telegraph wires, which will undoubtedly



TWO PARTS OF THE MAIN SWITCHBOARD.

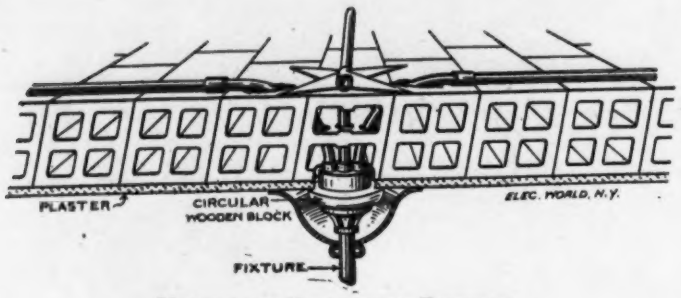


MOTOR DYNAMOS FOR CABLE AND TELEGRAPH SYSTEM.



TELEGRAPH SIGNAL AND CABLE TERMINALS.

be very numerous in offices in such a location. For this purpose another wire shaft is used. Running vertically in this shaft is a series of lead cables fastened to wooden blocks. This wire service has been divided into two classes—high potential series systems, such as ticker circuits, and low-potential, multiple systems, such as telephone circuits. For the first class a single twenty-wire cable is looped at each floor, and for the others a single 20-wire cable is separately run to each floor. These cables connect to signal panels set in boxes similar to those already described, such that the office wires may be connected on the front of the panel and the cable wires on the back. For the high-potential service a single iron-armored insulating conduit extends from the panel box to each room on that floor, where



Method of Connecting Fixtures.

it terminates in a double outlet box set in the wall so that one side faces the hall, the other the room. When it is desired to connect any office for such service, the wire may be pulled through this pipe without even entering the room and disturbing its occupants. After the wire is pulled in it is simply looped in its proper cable lead by taking out the short-circuiting wire normally connecting the loop-contact terminals.

For the telephone and other low potential service a line of ornamental trough moulding is run around the top of the walls through which wires can be brought from the panel to any office. This arrangement obviously allows any number of changes. All the cables run in the basement to terminal heads suitable for conduit leads.

The main office of the cable service is on the ground floor occupying the Broad Street end. Here the messages are received from the Coney Island cable station for general distribution. On the nineteenth floor of the building are the offices of Mr. Charles Cuttriss, the electrical engineer of the Commercial Cable Company. Here is done much of the testing and experimental work of this large cable system. Power for this purpose is supplied by a separate set of storage batteries, which are charged by several small Crocker-Wheeler and one Perret motor generators, shown in one of the illustrations.

A Study of Electcical Insulation.—I.

BY FREDERICK WILLIAM PHISTERER.

A study of electrical insulation seems naturally to divide itself into, first, a review of what has already been done—that is, a review of the state of the art; and, second, a more or less complete investigation along lines suggested by the well-known requirements for a perfect insulation.

As to the state of the art it may be justly said that so far as general information goes nothing is known about electrical insulations. Undoubtedly those companies which make or use large quantities of insulation have made very thorough investigations along this line. But this knowledge is their own and is retained for their own use. The engineering world knows nothing of their failures, from which many useful lessons could be drawn, or of their successes, further than the fact that they have put on the market a compound which has certain physical and electrical properties. There is practically no literature on the subject to which a beginner can turn, no record of methods and results from which the student, desiring to carry on further investigations, can learn what to avoid or even what it is useless to experiment with, because already thoroughly worked out. Such references as have appeared in the trade journals and magazines have generally been very short and of very little value. An effort has been made to collect references to such articles as seem to treat of this subject, and they are given in a table at the end.

Because of this almost entire lack of any foundation on which to build a study, it became necessary to begin at the beginning with such materials as could be obtained at the time and make a thorough investigation, obtaining failures from which to draw warnings, and possibly attaining some amount of success which might serve as guide posts for further research.

The requirements for a perfect insulation are well known. It should be, primarily, waterproof and fireproof. Waterproof, that is, it should not only not absorb moisture, but it should absolutely exclude it so as to prevent loss of energy by leakage and partial or complete short circuit. And fireproof so that it could not communicate flame to neighboring combustible material in case of an arc forming, at a break in the wire, due to mechanical injury. It should not be brittle even when chilled, but exceedingly tough, that is, difficult to fracture; very flexible, easily bent backward and forward, twisted and moulded; and it should have a very marked flow, or the power of closing again any cracks which may occur in it from any cause. It should not be hard unless it be intended for moulded insulators or bases for switches, cut-outs, etc.; when the harder it is, without being brittle, the more satisfactory will it be. It should have a very high melting point so as not to soften enough to allow the displacement of the wires which it surrounds when installed, as is sometimes necessary, near steam pipes or other sources of heat. And finally it should be easy of application and cheap to manufacture.

The plan as adopted consisted of a careful study of a number of materials which may be considered as the elements of electric insulation. The investigation was divided into two parts, first, as being least known, a study of the physical and mechanical properties; and second, a study of the electrical properties of such mixtures as the first investigation might point out as more or less satisfactory. Samples of the principal asphalts, hard and soft coal-tar pitch, three very satisfactory commercial compounds, all in themselves waterproof, but not fireproof; a sample of white paraffine wax, not now generally considered absolutely waterproof; and a sample of a new insulating material, known to be fireproof, but not waterproof, were obtained, and the experimental work carried on with these as explained later.

The following report is submitted without further explanation than is contained in it, except for the statement that it is not claimed for it that it is complete. So far as the twelve substances which were experimented with are concerned it is believed that it does cover the ground thoroughly. It is offered simply as a contribution to the literature of a branch of electrical engineering at present, so far as the literature is concerned, practically undeveloped; but one which, because of its great importance to the success of all electrical engineering design, construction and installation, deserves a most complete study and investigation.

RESULTS.—PART I.

The results of these tests for physical properties would seem to show that, so far as the materials used in them go, none of the asphalts nor hard coal-tar pitches make satisfactory insulations, in spite of their rather high melting points. They were all hard and brittle and entirely free from the three desirable qualities, those of toughness, flexibility and tendency to flow.

The one sample of soft coal-tar pitch was more satisfactory, although its melting point, 210° Fahr., was considerably below that of the asphalts and of the hard coal-tar pitch. It was fairly flexible under slow pressure, and showed a very marked flow. Under conditions where the chances are small of its being subjected to sudden blows or decided chilling, it would probably be fairly satisfactory. It is, however, rather brittle under sudden blows, and decidedly so when chilled.

The mineral wax, with its melting point at 235° Fahr., the sapho melting at 200° Fahr., and the ozite at 180° Fahr., all have toughness, flexibility and flow. The mineral wax is perhaps the toughest of the three, and the sapho has the greatest flow, though it is very hard to choose between them. The mineral wax best retained its toughness, flexibility and flow, and the sapho was most brittle when chilled.

The paraffine wax is now decidedly out of favor as an insulation, because it absorbs moisture to some extent.

Mixtures of mineral wax and either sapho or ozite in any proportion are recommended for their physical properties. They all have melting points at or near 210° Fahr., and either an equal amount or more toughness, flexibility and tendency to flow. In some cases these properties are so marked as to be but slightly affected by chilling.

Mixtures of mineral wax and the hard coal-tar pitch marked "S S S" in about equal proportions would have a somewhat higher

melting point—about 260°—and would be but slightly less tough and flexible than the mineral wax alone.

The same is true of mixtures containing sapho and the hard coal-tar pitch marked "S S S."

SULPHUR.

The results of the experiments with sulphur and the above-mentioned materials show that there is nothing to be gained by the use of sulphur either melted with or in chemical combination, with any of the substances used.

SILEX.

Thirty experiments show that small proportions of silex in combination with certain waterproof compounds have a bad effect. In ratios greater than 1.5 of silex to 1 of the other substance there is a steady rise in the melting point, without any special decrease in any of the other desirable properties. The melting point of the mixture can be made nearly double that of the waterproof compound alone, before a point is reached beyond which it is not advisable to increase the proportion of silex.

RESULTS.—PART II.

The data and results of the test of about fifty specimens for their electrical properties show that, while there was considerable range between the maximum and minimum voltages obtained, still all the specimens tested had a high insulating power for very thin pieces. The spark length necessary to cause the breaking down of the specimen varied from .03 to 1.30 inch per .01 inch of insulation. The corresponding variation in the voltage was from about 2300 volts to about 16,000 volts. This would denote that all the specimens tested would be satisfactory, whether applied directly to cotton coverings or used to fill tubes or cables.

GENERAL CONCLUSIONS.

In order to recommend any particular mixture from among those made and tested in these experiments, it would, to a certain extent, be necessary to know for what purpose and under what circumstances it was to be used. In a general way, those mixtures which showed little or no change in their physical properties, even when chilled, seem to be especially desirable. As all have fairly high "breaking-down" points, electrically there is but little choice between them, unless it be desired to make use of very much higher voltages than are used in ordinary practice to-day. The mixtures containing large quantities of silex are to be especially recommended for their very high melting points, their exceeding toughness, and their flexibility.

PART I.

PHYSICAL AND MECHANICAL PROPERTIES.

This part of the investigation consisted of an examination of the various materials, used separately and in combination with each of the others in different proportions, in order to obtain some idea of their physical and mechanical properties.

Each substance was first carefully examined, and as many of its properties noted as could be discovered. Then a portion was subjected to a slow heat until entirely melted, when its temperature was observed as accurately as possible. Then to other samples each of the other materials was added in the ratios of 4:1, 4:2, 4:3 and 4:4, and the melting point observed as before. These various mixtures were watched while melted and when cooling and cooled, and such observations as were made are given later in the report under the headings of the various substances.

REFINED TRINIDAD ASPHALT.

This refined Trinidad asphalt was obtained from the Barber Asphalt Paving Company, of New York City.

It was hard and not easily marked or scratched, and quite brittle when struck a sudden sharp blow. It broke easily into small pieces having a dull black surface and showed but little signs of flowing even after some hours.

It melted readily under a slow heat, reaching a temperature of about 350° Fahr., but did not become very fluid and when melted solidified quickly.

After melting and on again becoming cold, it seemed to recover all the properties noted at first. It was quite hard, breaking under a slight blow. It was somewhat brittle, showing a fine grained dull black surface in the breaks. Small pieces broke in the fingers without signs of bending and there was little or no flow.

These experiments show that as an insulation refined Trinidad asphalt cannot be used alone. The only point in its favor is its high melting point, 350° Fahr. Against its use are its hardness and brittleness and its lack of flexibility and flow. Mixtures containing large proportions of refined Bermuda asphalt, while but slightly less hard and brittle, displayed some toughness and considerable flow. The presence of refined California asphalt caused a more marked lowering of the melting point, but no particular increase of any of the more durable properties. All mixtures containing crude Trinidad asphalt were found to be even harder and more brittle than refined Trinidad asphalt alone, as well as to have a much lower melting point. No. 1 refined Trinidad asphalt caused little if any change in any of the properties of refined Trinidad asphalt. After the addition of a considerable quantity of soft coal-tar pitch the melting point was lowered by about 100 degrees, and while the substance was brittle under sudden blows, considerable flow was noticed. The action of mineral wax was to lower the melting point somewhat, but at the same time it markedly increased the toughness, flexibility and flow. The mixture still remained brittle to sudden blows when chilled. Sapho lowered the melting point more than mineral wax, but did not increase the desirable properties as much. Mixtures containing ozite had their melting point at about 260° and at ordinary temperatures were quite tough and flexible. Paraffine wax would markedly lower the melting point and very slightly decrease the hardness and brittleness.

Mixtures of refined Trinidad asphalt and refined Bermuda, refined California, crude Trinidad, and No. 1 refined Trinidad asphalts, soft coal-tar pitch, or paraffine wax would not be suitable because of their hardness and brittleness.

Mixtures of refined Trinidad asphalt and large proportions of mineral wax, sapho, or ozite, could with care be used, especially where the probability of chilling was not great. They all have a melting point higher than the insulating compounds now generally used, and are quite tough and flexible.

REFINED BERMUDA ASPHALT.

This material was obtained from the Barber Asphalt Paving Company.

It was quite hard, but plainly showed scratches on its surface. It was quite brittle and broke easily, or rather crumbled, when struck a sharp blow, into very small pieces having a bright, shining black surface. A few moments were sufficient to show a very marked flow.

It melted at 295° Fahr. and became quite fluid. It solidified rather quickly and on becoming solid broke into small pieces under light blows. The breaks were fine grained and dull black in color. The pieces would bend slightly under the pressure of the fingers before breaking and showed some signs of flow.

Used alone this material is not suitable for electrical insulation. Although its melting point is high and the flow considerable, still it is far too hard and brittle and has too little flexibility for this purpose. Adding refined Trinidad asphalt served to raise the melting point and increase the hardness and brittleness of the mixture. The presence of a large proportion of refined California asphalt in the mixture lowered the melting point somewhat and slightly increased the flexibility, but not enough to prevent the mixture from being decidedly brittle. Crude Trinidad asphalt greatly lowered the melting point and somewhat increased the brittleness. The chief effect of adding No. 1 refined Trinidad asphalt seemed to be a lowering of the melting point. The presence of a large proportion of soft coal-tar pitch had the effect of lowering the melting point to about 260° and so increasing the toughness and flexibility that the mixture became brittle only when decidedly chilled. The larger proportions of mineral wax gave a melting point ranging from 270° to 245°, and the mixture had to be chilled in order to cause fracture under sudden blows. Sapho lowered the melting point to about 230° and increased the toughness and flexibility at ordinary temperatures, but the mixture was decidedly brittle when chilled. A mixture containing any proportion of ozite had a melting point at about 245°, and was so tough, flexible, and had so much flow as to be but little affected by chilling. Paraffine wax would lower the melting point somewhat and made the mixture fairly tough and flexible.

Mixtures of refined Bermuda asphalt and refined Trinidad, refined California, crude Trinidad, or No. 1 refined Trinidad asphalts could not satisfactorily be used as insulations on account of their extreme hardness and brittleness.

Mixtures of refined Bermuda asphalt and the larger proportions of soft coal-tar pitch, mineral wax, sapho, ozite or paraffine wax, appeared to be quite suitable for this purpose. Especially mixtures containing mineral wax or ozite, as these mixtures were but slightly brittle even when chilled.

Transformer Efficiency.

BY PROF. HENRY S. CARHART.

In The Electrical World for September 25 Mr. Wolcott has very courteously criticised my demonstration that for the highest efficiency of a transformer the copper and iron losses should be equal. This criticism gives me occasion to explain more in detail what was only incidental in my paper on the design of a 1250-watt transformer.

Mr. Wolcott has very properly corrected the obvious error of writing $d\,I/d\,c$ instead of $d\,c/d\,I$. It was simply a careless blunder on my part which had already been detected. The bad example must have affected Mr. Wolcott's mathematical accuracy, for he falls into the same error by writing $d\,R/d\,c$ instead of $d\,c/d\,R$, where R is the independent variable.

Mr. Wolcott has apparently misunderstood my meaning expressed in a single short phrase. It was doubtless written too briefly to be clear. It is perfectly apparent that $d\,c/d\,I$ is a partial differential coefficient with a b E and R assumed as constants for the particular purpose in view. The conclusion from my equation is exactly as Mr. Wolcott understands it, viz., that a given transformer, working on a primary circuit of constant frequency, with a constant iron loss b and a constant resistance R, will have its highest efficiency when the secondary current is raised to a point where the copper and iron losses are equal. If the design of the transformer was bad, these equal losses might occur at a value of the current beyond the safe carrying capacity of the copper conductors. The principle must therefore be

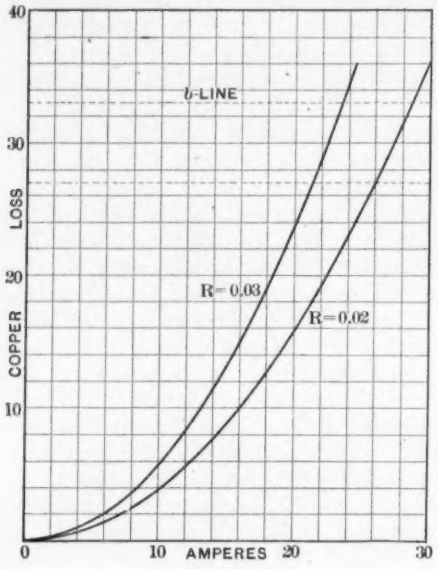


Fig. 1.

applied intelligently, due regard being paid to the rise of temperature of the transformer.

Mr. Wolcott assumes that I have gone further, and represents me as applying the same principle when the resistance is made the independent variable instead of the current. This I have not done, but it is true that the condition of maximum efficiency remains the same when one of the constants, as R, is made to assume different values. It is perfectly obvious, even to one who has not made a study of transformers, that the efficiency at all loads increases as the resistance diminishes, everything else remaining the same. It is also obvious that this condition cannot be met except by substituting for one conductor another of the same dimensions, but of lower specific resistance. Aside from this evident difficulty, let us suppose that the constant R is made to assume a smaller value, while I remains the independent variable. The resistance may be made smaller, either (a) by increasing the conductance per unit length of the conductor, or (b) by using a smaller number of turns. In case (a) for highest efficiency the current must be increased till the copper and iron losses are equal, when the point of highest efficiency is again reached. This is not an absolute maximum, but a maximum for the constants assumed. The change in the resistance means simply that the capacity of the transformer has been increased. Mechanically, the increase of copper involves an increase of iron and a larger iron loss; but the losses increase less rapidly than the capacity, and therefore the efficiency of large transformers is higher than that of small ones.

For case (b) the smaller number of turns of copper necessarily involves a larger cross-section and a larger volume of iron. To reach the point of highest efficiency in this case, with the iron and copper losses equal, the current might have to be raised to a point in excess of the safe-carrying capacity of the conductors. Both devices (a) and (b) are resorted to in passing from a transformer of one capacity to one of larger capacity.

Mr. Wolcott might equally well have drawn attention to the fact that a diminished iron loss, secured by a better quality of iron, also increases the efficiency of a transformer, and might have declared that therefore I have abused or misused the useful law of the maximum derived from an operation of the calculus. But is it not evident that the maximum efficiency with which I am dealing is the maximum corresponding to the constants b and R, and not an absolute maximum, which Mr. Wolcott appears to have in mind? If either b or R is changed the maximum efficiency changes, but it is still conditioned on the equality of the copper and iron losses.

The curves in Fig. 1 are plotted with the values of the copper losses $a\,I^2\,R$ as ordinates and the corresponding values of I as abscissas. In other words, the curves express the relation between the copper losses and the secondary current. If now the iron loss b is constant, and a horizontal line is drawn at a distance equal to b units above the base of the diagram, its intersection with the curve will show the value of the secondary current to give maximum efficiency for this value of b. Thus for b equal to 33 watts, the current at which the transformer, whose secondary resistance is 0.02 ohm, has its highest efficiency, is 28.7 ampere; for when I is 28.7, $a\,I^2\,R$ equals 33. The constant a is assumed to be 2. It is evident that as b is made less and less, the maximum efficiency of the transformer occurs at smaller values of the current.

In a similar way, if b remains constant, while R is made to assume smaller values successively, the maximum efficiency is found at successively larger values of the current I. Thus the b-line 33 intersects the curve for R equal to 0.03 at 23.4 amperes, and the curve for R equal to 0.02 ohm at 28.7 amperes. It is thus possible to reduce both

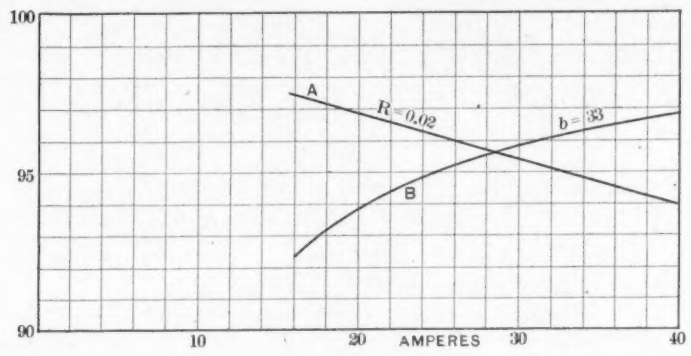


Fig. 2.

b and R in such a way that the value of I, or the load on the secondary, for maximum efficiency shall remain constant.

When b is made to vary the expression for the maximum efficiency is

$$\frac{1}{1+\frac{2a\,I^2R}{EI}} \text{ or } \frac{1}{1+\frac{2a\,IR}{E}}.$$

The value of this expression tends toward a limit of unity as I *decreases.*

On the other hand when R varies, while b remains constant, the expression for maximum efficiency is

$$\frac{1}{1+\frac{2b}{IE}}.$$

This expression tends toward a limit of unity as I *increases.* Fig. 2 shows the two curves of maximum efficiency for the constants a equals 2 and E equals 50. For the A curve R is 0.02 and b varies; for the B curve b is 33 and R varies. The constants employed in all these curves are nearly those of the 1250-watt transformer of my former paper. These curves show how the maximum efficiency which is reached when the copper and iron losses are equal is affected on the one hand by changing the constant b and on the other by changing R.

This law of highest efficiency may be employed with great advan-

tage in the design of transformers. Suppose the safe carrying capacity of the copper is assumed. If then the transformer is designed for power transmission, where, often at least, it is advantageous that the efficiency curve shall reach its highest point at full load, it is entirely practicable to design the transformer so that the copper and iron losses shall be equal at this point, provided, of course, that the magnetic constants of the iron are known. But if the transformer is intended for lighting and a high all-day efficiency is required, then it will be advantageous to so modify the design that the highest efficiency shall be reached at a half or three-quarters load. This is accomplished by increasing the number of turns of both primary and secondary and reducing the cross-section and volume of the iron. But the highest efficiency of such a modified transformer will be again reached when the copper loss $a\,I^2\,R$ equals the iron loss b. If b remains constant, I^2 and R may vary in any way possible, so long as their product remains a constant and equal to b/a; the value of I in each case will be the current in the secondary corresponding to the highest efficiency which the transforemr exhibits.

The designer may therefore readily predetermine the load at which the efficiency curve of a transformer of given capacity shall reach its highest point; and at this highest point of the efficiency curve the copper and iron losses are equal to each other.

The American Patent System—Changes Necessary to Adapt It to Existing Conditions and Future Development.

BY PHILIP MAURO.

The distinguishing and most important characteristic of the American patent system is the provision of law requiring an examination of all applications for patents, and the issue of a patent only in cases where it appears, as the result of such examination, that the alleged invention is novel and useful. This system was established at a time when the issued patents, which constituted the major part of the field of search to be explored in examining applications, were few and the number of applications relatively small. Conditions in these respects have greatly changed, though the change has been gradual. It has become more and more apparent that the patent system is being subjected to a great and accumulating strain in consequence of the continuous effort to adjust it to the continuously changing conditions. At the present day, the issued United States patents amount to nearly 600,000. These, with the numerous foreign patents and technical publications constitute an enormous mass of literature, the appropriate parts of which should be thoroughly and exhaustively examined in determining the novelty of applications for a patent. On the other hand, the number of applications for patents has meanwhile grown to about 40,000 annually. Thus the work to be accomplished at any given time by the examining corps of the Patent Office is the product of two factors. The rate of increase of that work is not a simple increase, like the growth of population, or in proportion merely to the growth of one of its factors, but is roughly the product of the one multiplied by the other.

The provision to meet this rapidly increasing demand for work has been by no means adequate, and without a radical change in the attitude of the national legislature toward the Patent Office, will never be adequate. On the contrary it is certain that, as the years pass, the discrepancy between the work necessary to carry out effectually the requirements of the law and the means available for that purpose will increase in magnitude.

The force of these considerations has long been felt and appreciated by persons conversant with the workings of the Patent Office. They have been pointed out frequently in reports of Commissioners of Patents, usually in support of a plea for an increased force and more ample facilities; but, as shown above, such appeals have never met and will never meet such response from Congress as to equip the Patent Office fully for the work required of it.

The results of these conditions thus far are mainly of two sorts: First, delays, vexatious and injurious to the interests of inventors; second, superficial or incomplete examinations. From the last result follows another more disastrous in its consequences than the two first named. Theoretically, a patent is *prima facie* valid, this presumption being grounded on the fact that, before its grant, the question of patentability has been exhaustively investigated and impartially decided by competent official experts. But practically, as every patent lawyer well knows, the action of the Patent Office has now so little weight with the courts that, for all the benefit a patentee derives from it, the patent might as well have been granted under the European system without examination. Patentees have in numerous cases suffered from the consequences of imperfect examinations, and not a few have been actually brought to ruin in the attempt to sustain in the courts patents granted for inventions adjudged by the Patent Office to be new and useful, and which purported to grant and secure to the patentees exclusive rights. The fate which many grants of the Government of the United States have met with in its own courts would be a serious reflection upon the administration of the Patent Office, but for the well-known fact that the responsibility rests with Congress in refusing to expend in the administration of the law the fees paid by patentees, these being allowed to accumulate idly in the Treasury. This accumulated sum amounts at the present day to about $5,000,000.

Returning to the two immediate evils of existing conditions, we find the Patent Office oscillating from one plan to another in the vain attempt to avoid both evils. Under one administration the demand from the head of the office will be for thorough work, with the result that the various divisions get more and more in arrears. Under another administration the demand will be to bring the work up to date, with the necessary consequence that it is not half done.

Realizing as we must that under the most liberal appropriations to be expected from Congress the Patent Office cannot efficiently carry out the present provisions of law with reference to the treatment of applications for patents, there remains but one course open, namely, to change the system.

In determining the direction and extent of the modifications necessary to meet existing conditions and to provide for further expansion, we have to consult our own experiences with the existing system and its results, and also the experiences of other nations where different systems prevail. As between the system of examination prior to grant, and that of granting patents without examination, the former is ideal so long as examinations are what they purport to be and what the law contemplates. When, however, the presumption of validity becomes a mere sham and delusion, it is manifestly far better and fairer to patentees and to the public to have it fully understood, as in England and France, that the patents are granted without guaranty of the Government, and that their validity must be tested and determined in the courts. We have, in fact, though unconsciously, and while preserving the form of our distinctive system, been drifting gradually toward that whch prevails in the principal European countries, the presumption of validity, based on examination, partaking less and less of the nature of a guaranty to the patentee that the rights granted and secured to him will be respected and enforced. This condition of a form of law without substance or reality should be brought to an end as speedily as possible.

The main ends to be sought in changing the system should be, first, to remedy effectually the existing evils and inconveniences, and, second, to preserve to the fullest extent the advantages which our system secures by reason of its distinctive features. Unquestionably, the chief advantage of the examination, conducted with the aid of the facilities which the Patent Office possesses in its library and records, is the information it gives to the patentee touching the prior state of the art to which his invention relates. An investigation, well and thoroughly conducted, gathers and makes easily accessible to the parties concerned all prior publications and patents that have a bearing upon the novelty of the supposed invention. In the writer's judgment, this advantage is one that should at all hazards be retained, it being well worth what it costs the inventors who pay for it, as well as being an immense benefit to the public at large, who defray no part of the expense.

As the result of this search by the examining corps, some applicants for patents are made aware at the outset that their supposed inventions are not novel. They are consequently saved much time, expense and trouble that would result from proceeding in ignorance of that fact. It is probable that nearly 25 per cent. of the applications for patents are dropped after the first official letter gives notice of the results of the search. In numerous other cases, constituting much more than half the total number, the results of the investigation show the necessity of modifying and restricting the claim and amending the specification. The examination is just as useful in these cases as in those just considered.

In all cases a record of the results of the investigations is made in the Patent Office, which record is available to the public, so that it can readily be consulted for information desired as to the validity and scope of the patent.

At present the time occupied by the force employed in

the Patent Office in simply making examinations and notifying applicants of the results thereof is but a small part of the total time consumed in the work of that office, as now carried on. Probably the greater part of the time of the examining corps is consumed in considering and deciding upon the validity and scope of claims, in hearing and passing upon arguments of inventors and their attorneys, in re-examining and considering such questions, and in defending their conclusions before appellate tribunals. The prosecution of an application for patent frequently assumes the form of a contest between the examiner and solicitor, carried on with great vigor on both sides and involving much expense and consumption of time.

Now let us ask and ascertain, if we can, what is the value to the inventors and to the public of these decisions or judgments of the examiners, or the many appellate tribunals to which rejected applicants may appeal (there are three successive appeals provided by law besides the ultimate remedy by bill in equity in a circuit court, with a further appeal from the judgment of that court), and which result finally in either the grant or refusal of the patent? Taking one in fifty as a liberal estimate of the proportion of patented inventions which actually go into commercial use, it follows that 98 per cent. of the work performed in reaching these decisions is absolutely barren of result. Whatever the proportion of commercially useful inventions may be, it will not be disputed by anyone conversant with the facts that the major portion of the time of the patent officials is consumed by deciding moot questions, or, in other words, is absolutely wasted.

As to the utility of the judgment of the examiner in the small number of patents that cover commercially useful devices nothing further need be said, attention having already been called to the fact that the decision of the Patent Office in favor of the patentability of the invention has little weight, and is of small advantage to the patentee.

In the other cases, *i. e.*, those in which the decision of the Patent Office is adverse and results in the refusal of a patent, we have no result to compensate for the waste pointed out above. There is more or less current a notion that the issuance of an invalid patent is a menace to the public and may become a source of injury. That notion, however, seems to have no substantial basis, and it is indeed difficult to conceive of anything more harmless than a void patent. On the other hand, the adverse decisions of the Patent Office are, in some cases at least, erroneous, and to that extent positive wrong and injury are caused.

Consideration of the facts brings us to the conclusions (1) that the time of the examining corps, so far as occupied by making investigations, is usefully spent, and the results are of great value both to patentees and to the public; (2) that such time, so far as occupied in making judicial decisions, is unprofitably consumed, and the results the reverse of advantageous. If these conclusions be sound, a complete remedy for the existing evils will be found, without sacrificing the peculiar benefits of the American patent system, by confining the Patent Office to the business of making examination, and relieving it of the business of making decisions, leaving the latter to the courts in the small number of cases where an authoritative judgment upon the validity or scope of a patent becomes necessary.

To apply this remedy would not require so great a change in existing law and practice as might be at first supposed. In outline the system would be about as follows: Applications to be prepared and filed in all respects as at present, and to be examined exhaustively both as to form and merits; the applicant to be notified as is now done, of every formal objection to which his specification and claims are open, and of all prior patents, etc., that anticipate his invention, or any part thereof, with such explanations as will enable him to comprehend the pertinence of the citations and the extent to which the novelty of his invention is confined by the prior art. As the result of this action applicants who find their inventions completely anticipated and not worth further expense, will drop them, as is now the case. A larger number will, as they do now, revise and amend their papers to distinguish what is new from what is old, and to restrict their claims in the light of the information which the official communication contains. Inasmuch as such amendments frequently introduce new claims or present the invention in a different aspect, let the applicant have, as under existing law, the benefit of a second examination with the right to amend in the light thereof. Here the functions of the Patent Office may usefully cease, all appeals and other proceedings being abolished. After finally putting his specifications into the form which the patentee, with the assistance and advice of his solicitor, deems proper, let the patent issue to him upon payment of the final Government fee, which, if a check upon the issuance of frivolous or invalid patents is deemed desirable, might be made larger than under existing law.

The plan herein proposed is, in its general features, by no means new; but it seems never to have received the attention which, in the writer's judgment, it merits. Now that the examination system is undergoing a severe and steadily increasing strain, a discussion of plans whereby those features of it which have the greatest value may be preserved, is most appropriate and timely.

Attention may be directed to one of the incidental benefits which would result from the proposed change, to wit, the abolition of the cumbrous and expensive interference procedure of the Patent Office, which is intolerably burdensome to inventors and without commensurate (if any) benefits. An interference is a proceeding wherein, after enormous cost and vexatious delay, one party or the other obtains an inconclusive judgment. Under the proposed new system interference would be left to the courts under provisions such as those of Section 4918 of the Revised Statutes.

No attempt will here be made to answer, by way of anticipation, objections or difficulties which may be suggested. The writer sees only one serious doubt or question to be considered, namely, whether a patent system in which the novelty and patentability of the invention are not adjudicated before issue of the patent, would be in accordance with the Constitution. The Constitution (Art. I. Sec. 8) empowers Congress to promote the progress of the useful arts by passing laws which will secure to inventors, for limited periods of time, exclusive rights in their discoveries. It may be suggested that a patent system to stand on this foundation, must be one which provides for the issue of patents only to persons who are actually inventors; that is, persons who have made new discoveries, and that the issue of patents cannot be so limited and restricted without a previous adjudication of novelty and utility. This is an extreme view, but at the same time, since it involves an interpretation of the Constitution, it is not to be dismissed without full consideration.

The limits of this article forbid any discussion of this question, and the writer will content himself with the statement of his opinion that a system, such as outlined above, would secure to inventors exclusive rights for limited times in their discoveries, and would not secure exclusive rights to things that were not discovered (*i. e.*, invented novelties) because the enforcement of the grant by the courts would depend (as it does under existing law) upon the novelty of the thing patented.

The American Electro-Therapeutic Association.

At the seventh annual meeting of this association, which was recently held at Harrisburg, Pa., the following named gentlemen were elected officers for the ensuing year: President, Dr. Charles R. Dickson, Toronto, Ont.; first vice-president, Dr. Frederick Schavoir, Stamford, Conn.; second vice-president, Dr. Caleb Brown, Sac City, Ia.; treasurer, Dr. Richard J. Nunn, Savannah, Ga.; secretary, Dr. John Gerin, Auburn, N. Y. Committees were appointed on the following named subjects: "Induction Coils and Alternators," "Meters," "Static Machines and Condensers," "Constant Current Generators and Controllers," "Electrodes," "Electric Light Apparatus for Diagnosis and Therapy and the Röntgen X-ray." Mr. A. E. Kennelly was appointed chairman of the committee on "Induction Coils and Alternators," and Mr. John J. Carty was made chairman on "Electric Light Apparatus for Diagnosis and Therapy and the Röntgen X-ray." A special committee on "Cataphoresis" was appointed, with Prof. A. E. Dolbear as chairman. The next meeting of the association will be held in Buffalo, N. Y., on September 13, 14 and 15, 1898.

A French Idea of New York's Electric Cab Service.

Our esteemed contemporary, *L'Electricien*, after reciting the number of passengers carried and the distance traveled by electric cabs in New York City during the month of June, quotes the tariff of prices, and says: "This is not particularly cheap, and if our worthy Parisian cabbies understood it, they would vote with hands raised for the adoption of the electric cab—at the same price."

Some Observations on the Dielectric Strength of Oils.

BY EDWIN F NORTHRUP AND GEO. W. PIERCE.

While engaged recently in the construction of a high-frequency apparatus it became necessary to know the insulating power of the oil we proposed to use, and we were thus led to make the following measurements.

We had at our disposal, as current sources, a high-frequency coil, capable of giving, when operated with an air blast, a smooth, continuous discharge through 10 inches of air, an induction coil giving, with a hammer break, a heavy 4-inch spark, and the same coil used as a transformer of the 100-volt alternating current of the city circuit to a potential which would discharge through about half an inch of air.

The strengths of transil oil, "Eldorado" engine oil and kerosene oil, as compared with air, were tested with each of the above current sources.

The alternative-path method was employed, due care being taken to make a symmetrical arrangement of the alternative paths, so that

TABLE I.

Transil oil compared with air. Current source, high-frequency apparatus:

Millimeters mean oil length.	Millimeters air length.	Ratio of oil strength to air strength.
2.15	30.	14.
2.70	40.5	15.
3.23	51.	15.8
3.36	61.5	18.
3.7	72.5	19.6
3.86	83.	21.3
4.3	93.5	21.5
4.6	104.	22.6
4.65	114.5	24.6
5.06	125.	24.6
5.06	135.	26.7
5.23	146.	27.7
6.02	156.5	26.
6.63	164.9	24.8

The numbers of the first column are the means of three readings with a maximum difference from the mean of 7 per cent.

TABLE II.

Transil oil compared with air. Current source, transformer.

Millimeters oil length.	Millimeters air length.	Ratio of oil strength to air strength.	Time.
.5	3.9	7.8	Instantaneous.
.6	4.0	6.7	"
.7	3.0	4.3	"
.8	2.2	2.8	"
.9	3.4	3.8	"
1.0	3.5	3.5	"
1.1	4.0	3.6	"
1.2	3.9	3.3	"
1.3	4.4	3.4	"
1.4	4.8	3.4	"
1.5	4.9	3.3	"
1.6	5.1	3.2	"
1.7	5.2	3.1	"
1.8	5.3	2.9	"
1.9	5.5	2.9	"
2.0	5.2	2.6	"
2.1	5.7	2.7	"
2.2	5.8	2.6	"
2.3	5.8	2.5	"
2.4	5.8	2.4	"
2.5	6.0	2.4	"
2.6	6.3	2.4	"
2.7	6.8	2.5	"
2.8	6.9	2.5	4 seconds.
2.9	6.9	2.4	6 seconds.
3.0	6.9	2.3	7 seconds.
3.1	7.1	2.3	8 seconds.
3.2	7.2	2.25	36 seconds.
3.3	7.2	2.2	1 second.
3.5	7.2	2.1	2 seconds.
4.0	7.2	1.8	1 second.
4.5	7.5	1.7	3 seconds.
5.0	7.5	1.5	11 seconds.
5.5	7.6	1.4	9 seconds.
6.0	7.6	1.3	Instantaneous.
6.5	7.6	1.2	9 seconds.
7.0	7.6	1.1	54 seconds.
7.5	7.6	1.0	12 seconds.
8.0	7.7	1.0	166 seconds.
8.5	7.7	.9	280 seconds.
9.0	7.7	.9	100 seconds.
9.5	7.7	Neither air nor oil broke in 10 minutes.	

The oil was stirred after each spark.

When the oil breaks down it does not always continue to permit the spark, but after a time again breaks.

The disruption of oil with long exposure to high potential cannot be due to leap-up of potential of line as an alternative air path smaller than the oil path was in parallel in the last observations.

TABLE III.

Transil oil compared with air. Current Source. Induction coil with hammer break.

Millimeters. oil length.	Millimeters mean air length.	Ratio of oil strength to air strength.
.8	3.1	3.9
.9	4.2	4.7
1.1	5.2	4.7
1.6	7.3	4.6
1.7	9.5	5.6
1.7	11.5	6.8
2	13.6	6.8
2.25	15.7	7.
2.2	21.	9.5
2.7	21.5	11.7
4.2	42.	10.
4.5	52.5	11.7
5.3	63.	11.9
6.	63.	10.5
6.5	63.	9.7

In the last three measurements time exposure was made, but as should be suspected no weakening of oil occurred.

TABLE IV.

"El Dorado" engine oil compared with air. Current source, high-frequency apparatus.

Millimeters. mean oil length.	Millimeters air length.	Ratio of oil strength to air strength.
1.03	30.	29.1
1.3	40.5	31.1
1.63	51.	31.3
1.86	61.5	33.1
1.93	72.	37.3
2.13	82.5	38.
2.5	93.	37.5
2.73	104.	38.1
3.03	114.5	37.8
3.36	125.	37.2

The numbers of the first column are the means of three readings, with a maximum difference from the mean of 11 per cent.

TABLE V.

"El Dorado" engine oil compared with air. Transformer current.

Millimeters oil length.	Millimeters air length.	Ratio of oil strength to air strength.	Time exposed.
.5	2.9	5.8	Instantaneous
.6	3.8	6.3	"
.7	4.5	6.5	"
.8	4.7	5.9	"
.9	5.	5.6	"
1.	5.1	5.1	"
1.1	5.8	5.3	"
1.2	6.1	5.1	"
1.3	6.2	4.7	"
1.4	6.3	4.5	"
1.5	6.3	4.2	"
1.6	6.4	4.	"
1.7	6.6	3.9	"
1.8	7.	3.9	"
1.9	7.	3.7	"
2.	7.	3.5	"
2.1	7.7	3.7	"
2.2	7.7	3.5	"
2.3	7.7	3.5	"
2.3	7.8	3.4	"
2.4	8.5	3.5	"
2.5	8.5	3.4	1.5 seconds
3.	8.5	2.8	3 "
3.5	8.5	2.4	6 "
4.	8.5	2.4	22 "
4.5	8.5	1.9	4 "
5.	8.5	1.7	6.5 "
5.5	8.5	1.5	11 "
6.	8.5	1.4	132 "
6.5	8.5	1.3	24 "
7.	8.5	1.2	45 "
7.5	8.5	1.1	20 "
8.5	8.5	1.	325 "
8.5	8.4	.99	325 "
8.5	8.2	oil did not break down	

The oil was stirred after each spark. The temperature of oil did not rise appreciably.

the drop in potential due to impedance would be the same in the two paths. The discharge took place between brass balls 2.2 centimeters in diameter, their separation being adjusted by micrometer screws. The accuracy of the method with each source of current was several times examined by having air in both paths. With the high-frequency apparatus the lengths of the alternative discharges agreed with each other within a maximum difference of

TABLE VI.

"El Dorado" engine oil compared with air. Current source, induction coil, with hammer break.

Millimeters oil length.	Millimeters air length.	Ratio of oil strength to air strength.
.8	3.1	3.9
.97	4.	4.3
1.1	5.2	4.7
1.2	7.3	6.1
1.44	9.5	6.6
1.7	11.5	6.8
1.5	13.6	9.1
1.6	15.7	9.8
2.07	20.	10.
1.9	31.5	16.1
2.8	42.	15.
3.3	52.5	16.

TABLE VII.

Kerosene oil compared with air. Current source, high-frequency apparatus.

Millimeters mean oil length.	Millimeters air length.	Ratio of oil strength to air strength.
.63	30.	47.6
.8	40.5	50.6
1.13	51.	45.1
1.3	61.5	47.3
1.26	72.	57.1
1.4	82.5	58.9
1.46	93.	63.7
1.53	103.5	67.5

The numbers of the first column are the means of three readings, with a maximum difference from the mean of 10 per cent.

TABLE VIII.

Kerosene oil compared with air. Current source, transformer.

Millimeters oil length.	Millimeters air length.	Ratio of oil strength to air strength.
.1	2.1	21.
.1	2.1	21.
.1	2.1	21.
.1	3.1	31.
.1	3.1	31.
.1	3.1	31.
.15	4.2	28.
.3	8.	26.6

As seen in this table, for very short sparks in the oil the method employed is quite inaccurate. The results are given as observed. No weakening of the oil was noticeable even when exposed for a long time to the high potential of the transformer.

TABLE IX.

Kerosene oil compared with air. Induction-coil current.

Millimeters oil length.	Millimeters air length.	Ratio of oil strength to air strength.
.3	3.1	10.3
.3	4.2	14.
.4	5.2	13.
.45	7.3	16.2
.5	9.4	18.8
.7	11.5	16.4
.7	13.6	19.4
.9	15.7	17.4
.8	21.	25.
1.1	31.5	29.
1.2	42.	36.6
1.5	52.5	35.

7 per cent. With the discharge of the induction coil the error was not over 8 per cent., and with the transformed city circuit it did not exceed 5 per cent.

One of the most striking properties of the transil oil and the engine oil is that when exposed for a long time to high potentials of low frequency they show a decided weakening, becoming finally actually weaker than air. As the tables indicate the strength of an oil is very different for different current sources.

By reference to Table X. it is seen that, for all of the currents used, kerosene oil is a stronger insulator than either of the other oils.

With high-frequency currents and induction currents all of the oils increase markedly in strength as the potential increases.

With the high potentials of the transformer acting for long periods both the transil oil and the engine oil are about equal in strength to air. It is, however, an advantage to use oil in insulating many forms of apparatus subjected to these currents, as the oil prevents surface conduction and surface disruption. For example, a condenser with glass dielectrics is better insulated for transformer potentials if immersed in oil, for a discharge will take place more readily along a *surface* of glass when in air than when in oil.

While in these investigations high refinement of measurement was not aimed at, precautions were taken to avoid hidden errors in the results.

The variation of the ratio of oil strength to air strength with variation of potential was not due to heating of the liquid, as its temperature did not appreciably change. Nor were the ratios affected by the varying capacity of the discharges, as the capacity of a considerable area of tin plate in parallel with the oil gap was found not to affect sensibly the readings.

In stating the dielectric strength of an oil it is important to give the current source, and tables are valueless where this is neglected.

TABLE X.

Brief comparison of results. The numbers give the maximum and minimum ratios of oil strength to air strength through the range tested.

	Current.		
Kind of Oil.	High Frequency.	Transformer.	Induction Coil.
Transil	14 — 24.8	7.8 — .9	3.9 — 9.7
Engine	29.1 — 37.2	5.8 — .99	3.9 — 16.
Kerosene	47.6 — 67.5	21. — 26.6*	10.3 — 35.

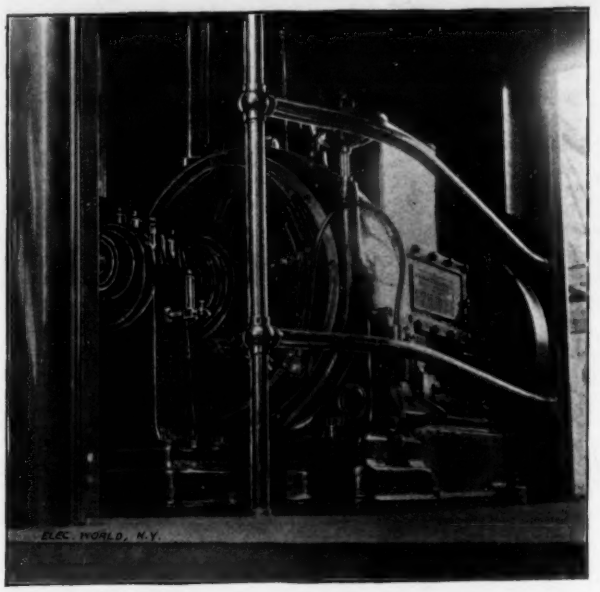
*These ratios are uncertain.

Combined Electric and Steam Traction.

Discussing the application of electricity to steam roads, The Electrical World of recent date stated that "street-railway cars are gradually being made larger, heavier and better equipped, until there is now no reason why the same cars should not be run at high speeds over private rights of way between cities, and over the street-car tracks at ordinary speed in the business centres." It may be of interest to note that during the past summer this idea has been carried out with remarkable success at Wilkesbarre, Pa. The Wilkesbarre & Northern Railroad extends to Harvey's Lake from Wilkesbarre, a distance of 16 miles. The Wilkesbarre & Wyoming Valley Traction Company operates all the street-railway lines radiating from the city. On July 1 last a novel and very popular car service was inaugurated between Wilkesbarre and Harvey's Lake, the route being 4 miles out through the city and neighboring towns over the traction company's tracks, and then over the Wilkesbarre & Northern's tracks on private right of way for a distance of twelve miles. The cars used were built by the Jackson & Sharp Company, are 40 feet in length, with cross seats for forty passengers, and weigh about 12 tons. Over the street-car lines the motive power is electricity, the cars being equipped with heavy motors, but at the Wilkesbarre & Northern connection the trolley is tied down and a light passenger locomotive attached. The run of 12 miles after leaving the street-car line is made in thirty-five minutes, with a stop about every mile. This is as fast as passenger trains are usually run on branch roads, and the novel combination provides a service unexcelled. Each motor car will pull two trail cars, and occasionally when handling a heavy traffic two trolley trains are run out on the same time over the traction line, and are coupled together at the Wilkesbarre & Northern connection, where the locomotive takes the train of six cars out to the lake. The road was operated very successfully last summer under this plan. On July 5, with but six cars in the service, more than 2,000 passengers were handled each way, the receipts being more than $1,000 for the day. The regular schedule time for the 16 miles, which includes 4 miles through the streets, where stops are frequently made, is one hour, a result which could hardly be attained by any other plan which would distribute the passengers so conveniently through the town and in the city. A system of air brakes is used, both on the Wilkesbarre & Northern and on the Traction Company's lines. There is a probability that the passenger service on the Wilkesbarre & Northern will be operated by electricity next year, but freight will continue to be handled by steam locomotives.

The Lighting of the "Lake Shore Limited."

A complete new train equipment has been built by the Wagner Palace Car Company for service over the New York Central and Lake Shore and Michigan Southern railways, between New York and Chicago. The train will be known as the "Lake Shore Limited," and will make the run in twenty-four hours' time. Five complete trains have been built, of which one will be held in reserve, each train making the round trip in four days. The cars are built on a scale of elegance equal, if not superior, to anything heretofore attempted.



GENERATING SET SEEN FROM BAGGAGE CAR DOOR.

Each train consists of seven cars, as follows: A combination baggage and buffet smoking car, with barber shop, bath room, etc.; a dining car, a drawing-room car, three sleeping cars and a compartment observation car. The cars are finished in a highly artistic style, each one differing from the others in the train.

The train is lighted by either the Pintsch gas system or electricity. For the lattter, an isolated plant is provided in the baggage compartment of the forward car. This plant consists of a Westinghouse standard engine, direct-connected to a Westinghouse multipolar dynamo mounted at the forward end of the car, the shaft running across the car. The unit is rated at 17½ kilowatts, the over-all dimensions of the bed-plate of engine and dynamo being 64 by 36 inches. The engine and dynamo shaft are made in one piece in order to do

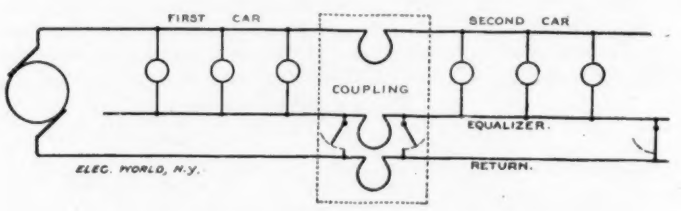
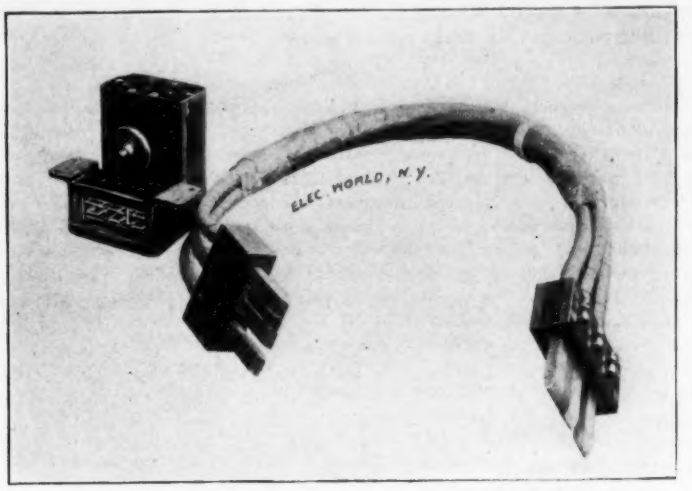


DIAGRAM OF EQUIPOTENTIAL SYSTEM.

away with the coupling, and thereby economize space. The centre bearing, which forms a cap on the oil chamber of the engine, is split in such a manner that this crank and armature shaft can be readily removed when necessary. The engine cylinders are 7½ inches in diameter, with a 7-inch stroke, and the speed is 400 revolutions per minute. The dynamo is six-polar, compound wound, designed for constant potential at 120 volts. The engine is supplied with steam from the locomotive, through a 1½-inch steam coupling, the pressure being lowered by a reducing valve on the locomotive to 80 pounds to the square inch. The steam for train heating comes through the same supply pipe, the pressure in the train pipe being controlled by the engineer of the lighting plant to suit the weather.

To provide for lighting when the locomotive is removed the main switch is made double-throw, so that the load may be thrown either on the engine or on a special feeder, which is connected with a coupling on the front platform. At all points where locomotives are changed, flexible leads will be provided from the station-lighting system. By attaching these leads to this coupling and throwing the main switch over, the lighting of the train will be effected from the station circuits while the locomotives are being changed. The distribution of current through the train is effected on the well-known three-wire, equi-potential system, the return wire and equalizer being joined together at the rear end of the train. The couplings for the electrical circuits have been greatly improved over previous practice. The plugs push in horizontally, and are clamped by a wing nut, but in case the cars are separated without uncoupling the electric circuits the plugs will pull out without injury to any of the parts. Each coupling is provided with a switch to join the return wire to the equalizer, which must, of course, always be done on the rear platform of the train. This switch is operated only by a



THREE-WIRE COUPLING AND PLATFORM SOCKET.

wrench, so that unauthorized persons cannot tamper with the circuits. The mains throughout the train are of No. 00 gauge, the flexible coupling leads being of the same size.

Each car is individually wired up on four circuits, the main switches of which are placed in the linen locker. The aisle lights are divided into two circuits, one of which can be turned out after midnight. The other two circuits carry respectively the section lights and the end-room lights. Between the sections are placed Gibbs' patent berth lights at a convenient height for reading in a reclining attitude. Each of these lights illuminates two berths, and is provided with hoods on both sides. In case both hoods are closed the light is turned off by an automatic switch. In the compartments and drawing rooms, the lights are grouped on individual switches for each room. The aisle lights are tastefully grouped around Pintsch gas burners of ordinary design. Outlets have been provided in all the cars for the attachment of electric fans in the hot season. The total number of lights in a train is 330, and the average evening load is about 125 amperes.

An interesting demonstration of the stiffness of the modern full-width vestibule and the high resilience of car springs is shown by the fact that while no vibration is noticeable through the body of the train, the rear end of the last car vibrates vertically almost as much as the dynamo end 600 feet away. This vibration is, of course, only noticeable when the train is standing. When the train is running there is no apparent sound or vibration even in the dynamo room.

A Last Resort.

An advertisement in our contemporary, the Hokah (Minn.) *Sun* reads as follows:

"A telephone line has been established between Hokah and Caledonia, and will be a great boon to the public, as you will be able—at any time—to call up J. W. Potter, undertaker, embalmer and funeral director, of Caledonia, and he will fill your order and deliver same to any place desired, direct funerals, furnish hearse and everything needed in such cases, without delay or inconvenience, and at reasonable prices. He understands his business, and will attend to it on time. He asks your patronage and guarantees satisfaction. Night or day he can be found at his place of business. I am at your service,

J. W. POTTER.

Caledonia, Minn.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

LIGHTS AND LIGHTING.

Constant Potential Arc Lamp. BARDON SYSTEM. *L'Ind. Elec.*, Oct. 10.—An illustrated description of this new type of lamp for continuous and alternating currents; the brake system is used.

POWER.

Laval Turbine. REYVAL. *L'Ind. Elec.*, Oct. 10.—A short article on this turbine at the recent exhibition at Stockholm; pressures from 50 to 220 atmospheres were used; the construction is such that these exceedingly high pressures are really a way of securing safety, as the water and steam space is reduced to a minimum; the steam generator, which resembles the well-known Serpolet boiler, consists simply of a very thick iron tube having a very small diameter and wound in a spiral, the water being introduced continuously. A generating station of 100 horse-power, including boiler, pump, condenser, turbine and dynamo, occupies a space of only six by four metres.

Electrically Driven Boiler Pumps. SIMON. *L'Elec.*, Oct. 16.—A short article pointing out the advantages and economy in the use of electrically driven pumps for supplying the feed water of boilers; the economy is claimed to be very great over direct-acting steam pumps; in one case an economy of 14 per cent. is said to have been gained by the use of the electrically driven pumps.

Three Rivers Power Plant. LEYDEN. *Can. Elec. News*, Oct.—A long, illustrated description of this plant, which has been in operation for six months; the transmission is over a distance of 17 miles and at present 600 horse-power are received; it is claimed that the most interesting feature is the novel method in which the new two-phase power, which is transmitted, is applied to an old electric-lighting plant in which the single-phase system and the series arc system are used; there were very few changes; the current is generated at 2400 volts and a frequency of 16,000; it is raised to 12,000 volts by step-up transformers; the old alternator is used as a synchronous motor operating on one of the phases, to drive the arc machines.

TRACTION.

Electric Carriages. CLAUDE. *L'Ind. Elec.*, Oct. 10.—A long article discussing a number of factors involved in the construction of such carriages. Under the heading of the choice of the vehicle he shows that the whole type of the vehicle must be quite different from the older forms, being constructed with reference to the new conditions; what is known as the bicycle construction should be used, economizing material as much as possible. He deduces the equation $k\ (M+y) = x\,y$, in which M is the weight of the carriage in kg, y that of the accumulators, x their specific energy in watt-hours per kg, and k the mean specific energy required for traction during a day, expressed in watt-hours per kg of total weight; this he solves for y, which gives the weight of the accumulators as a function of their specific capacity, and he shows that this is the equation of a hyperbola, and not of a straight line; he gives this curve for a vehicle weighing 800 kg and for $k = 8$ watt-hours; according to Hospitalier, a mean of 100 effective watt-hours per ton kilometer is required for one having pneumatic tires and ball bearings; he shows that a battery, no matter what its weight, would not be sufficient without recharge during the day, if its specific capacity is equal to or less than eight watt-hours per kg; the best at present attained seems to be that of the Fulmen accumulator, which is thirty watt-hours per kg, which in the example given shows that a battery of about 300 kg would be required; besides reducing the weight of the battery the other important point is to reduce very greatly the present "ruinous cost of maintenance"; to count on charging the battery twice a day would reduce the weight of the accumulators more than one-half, but this diminishes very greatly the daily efficiency of the carriage, unless the charging is done at a very rapid rate. He then points out the importance of the air resistance, giving a curve of the power necessary in watts per sq. meter of surface in still air, in terms of the speed; as an illustration he assumes a wind of six meters per second, which not infrequently occurs, and a speed of four meters per second and shows that this requires a power ten times greater than the mean. He discusses the choice of the motor; preference seems to have been given to the series motor, although at first sight the shunt motor would seem to be preferable, the case being different from that of railways; he recommends the use of a single motor. He then gives some figures for American vehicles of different kinds, and compares them with those of the Krieger vehicle, including a table of estimated costs in detail, the total cost per day per carriage being $1 63, while the corresponding cost for animal traction is $3.09.

Jungfrau Mountain Railway.—L'Ind. Elec., Oct. 10.—An article giving descriptions and data.

Possibilities of Rapid Electric Travel. DAVIS and WILLIAMSON. *Eng. Mag.*, Nov.—The second portion of their article (see *Digest*, Oct. 16). In the present portion they discuss the cost and the probable return upon the investment in that proposed road from Philadelphia to New York. The figures which are made a basis in their calculations, are all given and the costs are stated in detail in a table, from which it appears that the grand total of the first cost, including, it seems, all possible items, such as interest, taxes, etc., is $190,000,000, or about $745,000 per mile, the road being 85 miles long; they claim to have used liberal figures and believe that an overestimate has been made. They then figure on the cost of operation and probable errors; they count on 200,000 passengers per day and 500 trains per day; the estimated operating expenses are given in a table showing a saving of 57.3 per cent. of the expenses of the present steam railway; the latter per train mile is estimated to be 60 cents; if the savings balance the additional items chargeable to the electric road, the expenses would of course be the same; they estimate the total expenses per year besides a dividend of 4 per cent. on the proposed stock; they figure out the profits to be about 30 per cent. of the gross receipts. In conclusion the principal laws of electric railway traveling are given within a community, or between two communities. They believe to have shown that the headway and power questions can be solved, and that the cost of construction is not excessive; they are even convinced that greater speeds can be maintained.

Traveling Platform at the Paris Exposition.—Eng. Mag., Nov.—An abstract of a recent very fully illustrated article in *Génie Civil*, July 3. The difference between this and the one at Chicago is said to be mainly in the details and the magnitude; there will be two speeds and the power will be supplied by electric motors; the line will form a continuous circuit of about three miles; the platform will consist of two entirely distinct portions each with its own motive power, the high speed being about six miles an hour and the slow one three miles, while the stationary sidewalk will run the entire length of the circuit; it is estimated that 50,000 passengers can be transported per hour.

Canal Haulage.—Elec. Eng., Oct. 21; *West. Elec.*, Oct. 30.—A short abstract, with some of the illustrations and data, of the descriptive article which was noticed in the *Digest*, Oct. 16. The *Elek. Anz.*, Oct. 14, begins a more fully illustrated German translation of the article by Dupuy which was noticed in the *Digest*, Oct. 2.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Central Stations in Germany. LUX. *Zeit. f. Beleuchte.*, Oct. 10.—The conclusion of his article (see *Digest* Oct. 23); a number of large tables containing data of interest are given.

Feeder System and Switch Gear.—Lond. *Elec. Eng.* and *Elec.*, Oct. 27.—An appendix to a recent paper by Andrews, the latter journal describing only the feeder system. In the switch which is for high tension work, the break is through water, enclosed in an earthenwork pot; the switch contact is metallic, but the break occurs in water, which is at a slightly higher level than the uppermost part of the fixed contact, thus compelling the arc to pass through the water. The feeder system was devised to prevent a short circuit from interrupting the supply to any one of a number of substations; it is in effect a duplicate system of feeders with cut outs arranged in such a way that both ends of a faulty feeder shall be opened immediately when there is a short circuit or a heavy fault; for a single substation, two systems of feeders would be required, but for two sub-stations in the same direction a feeder connecting them suffices, while for any more distant sub-stations there is a connection to each of two of the nearer substations so that in any case with an interruption on any one feeder there is always a second one through which the supply can take place; at the station ends of these feeders there are fuses, while at the far ends there are return current cut-outs, their object being to supply the full current in the outgoing direction, but to cut-out with comparatively small currents returning from the sub-station to the generating station; the system has not yet been tried on a commercial scale but on a model it was possible to

short-circuit the feeders in any position without extinguishing any of the lamps representing the sub-stations.

Capital Outlay, Receipts and Expenditures.—Lond. *Elec.*, Oct. 22.—A large table issued in the form of a supplement, giving this data for the year 1896-7, for the statutory electrical supply undertakings in London and the provinces; no general summary is given. In an editorial on this subject attention is called to the thriving condition of this industry; there are at present over 100 stations in London and the provinces, with an aggregate capital expenditure of $50,000 000 and a total lamp connection of not less than 3,000,000; the money is yielding a fair return; electricity now competes with gas in cost; for six continuous-current stations in London the capital per unit of output was about $1 03, the lowest being about 51 cents. Attention is called to the small proportion which the coal bill of a station bears to the total annual expenses; of the sixty-two stations mentioned in the table the generating expenses average only 50 per cent. of the total, and the coal bill averages only 42 per cent. of this percentage, so that the cost of coal is only about one-fifth of the total cost of the unit.

Municipal Plant at Detroit.—Elec. Eng., Oct. 21.—A reply by Hudson and Starring to a recent editorial in that journal; they claim that it is not so much a reduction in cost as an increase in the quality of light which was the principal advantage gained in that municipal plant; the cost, however, has been larger than it will be in the future; no allowance was made for insurance because the building was fireproof; comparative costs to be correct should take into account the increase of the light and the greater reliability; the output is soon to be increased, which will reduce the relative operating expenses. The same issue contains a long editorial reply.

Private Plant—West. Elec., Oct. 30.—A brief illustrated description of a 1100-hp private plant in a department store in Chicago. The plant is a very large one, comprising thirty-eight engines and seventeen dynamos.

WIRES, WIRING AND CONDUITS.

Wiring Accessories.—L'Elec., Oct. 16.—The beginning of an illustrated translation in abstract of a paper by Hundhausen (see *Digest*, Feb. 6 and 20) describing the new system of Siemens and Halske, which consists of simple apparatus for forming junctions and branch connections with wires and cables.

Rules and Regulations in Switzerland.—L'Elec., Oct. 16.—A reprint of the rules for electrical installations in Switzerland.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Rays.—Proc. Lond. Phys. Soc., Oct.—A number of abstracts of recent articles, many of which have already been noticed, though as a rule more briefly, while others are of interest to physicists rather than electricians. In an abstract from the Italian of an article by CAMPETTI, it is stated that the action of the rays on air is the same as that produced by electric sparks and that which accompanies the process of combustion; the discharge of electricity by the gas acted upon is related to an increase of electrical conductivity in the gas itself.

Magnetic Deflection of Cathode Rays. KAUFMANN. *Wied. Ann.*, 61, p. 524; abstracted in the *Proc. Lond. Phys. Soc.*, Oct.—He shows that the difference of potential between the anode and cathode in the vacuum tube is the only element which determines the deflectibility of the rays, all other factors exerting only an indirect influence; the deflectibility as measured by the curvature of the rays is inversely proportional to the square root of the difference of potential.

X-Rays in 1708. COSMOS, Oct 9.—A short article referring to a recent supposed anticipation which was noticed in the *Digest* July 17. The Italian physicist, Marangoni, repeated the experiment of Hauksbee, which was supposed to show an anticipation, and arrives at the conclusion that the light effects of Hauksbee were due to diffuse discharges and not to X-rays.

Variations of Resistance of Solutions with Temperature and Pressure. LUSSANA, *Nuovo Cimento*, p. 357 and 441; abstracted in the *Proc. Lond. Phys. Soc.*, Oct.—He gives the following conclusions: That the electrical resistance of solutions sufficiently dilute diminishes for an increase of pressure, the diminution being rapid at first and then more slowly as the temperature is raised, and there seems to be a temperature of inversion; the diminution is not proportional to the pressure, but grows much less rapidly; the variation with temperature increases with the increase of pressure for the more dilute solutions, but diminishes for the more concentrated ones; an increase of pressure increases the degree of ionization and diminishes the frictional resistance of the ions.

Equipotential Surfaces. POMEY. *Ann. Télégraphiques*, 33, p. 165; abstracted briefly in the *Proc. Lond. Phys. Soc.*, Oct.—He deals with three problems with the aid of Laplace's equation.

Magnetic Properties and Electrical Resistance of Iron Dependent Upon Temperature. MORRIS. *Proc. Lond. Phys. Soc.*, Oct.—A reprint in full of his long paper, which was noticed in the *Digest*, June 5; it includes a large number of tables and curves, including several large folded plates. A brief abstract is published in the Lond. *Elec. Rev.*, Oct. 22.

Terrestrial Magnetism. WILDE. *Comptes Rendus*, 125; noticed briefly in the *Proc. Lond. Phys. Soc.*, Oct.—He describes an apparatus for demonstrating the elements of terrestrial magnetism and the secular variations; it consists of two globes, one inside of the other, both being magnetized by equatorial coils; the axis of the globes being inclined to each other.

Cold Dielectrics ABEGG. *Wied Ann*, No 10; abstracted in the Lond. *Elec.*, Oct. 22.—He criticises the abnormally high values obtained by Dewar and Fleming for very low temperatures for the dielectric capacity, as they do not agree with the author's formula; he attributes the results to the persistence of the polarization after the current has been broken, the persistence being caused by the excessive cold.

Rates of Depolarization. KLEIN. *Wied. Ann*, No. 10; abstracted briefly in the Lond. *Elec.*, Oct. 22.—He investigated the rates of depolarization of mercury and platinum electrodes of greatly different areas; he found that the area did not make any difference, but that the rate of depolarization was considerably retarded by prolonged polarization and by cold.

Zeeman Effect. KOENIG. *Wied. Ann.*, No. 10; abstracted in the Lond. *Elec.*, Oct. 22. He describes a differential method for observing this phenomenon, which gets rid of some of the difficulties; the new method is of advantage specially in obtaining photographs of the phenomenon.

Electrical Tension at the Poles of an Induction Coil. OBERBECK. *Wied. Ann*, 9, p. 109; abstracted briefly in the *Am. Jour. of Sc.*, Nov.—He made an investigation of the subject of the E. M. F. necessary to produce a spark of a certain length and shows that the maximum rise of the curve of E. M. F. produced by breaking the primary circuit, should be the starting point in an investigation of this subject; he finds that 60,000 volts can produce under certain conditions a stream of sparks more than 10-cm. (4 inches) in length; the experiments of Trowbridge with a 10,000 cell storage battery lead the "author of this note" to conclude that E. Thompson's statement that a striking distance of 80 cm. requires about 500,000 volts is nearer the truth than Heydweiller's claim that 100,000 would be nearer the truth (it is not clear from the abstract whether the latter conclusion is that of Oberbeck, or of the abstractor, "J. T.").

Rarefied Gases in a High Frequency Field. EBERT and WIEDEMANN. *Wied. Ann.*, 9, p. 187; noticed briefly in the *Am. Jour. of Sc.*, Nov.—Faraday showed that no electricity could be perceived inside of a metallic cage the exterior of which was connected to the ground; in the present article it is shown that this is not correct when the space inside of the cage is filled with rarefied gas; in order that the charge should penetrate through the holes of the metallic net into the interior, a rarefied gas must exist on both sides of the net.

Apparatus for Generating Lenard Rays. DES COUDRES. *Elec. Eng.*, Oct. 28.—A reprint, with the illustration, of the abstract notice in the *Digest*, Oct. 16

Solenoid Electromagnet. WARREN. *Chemical News*, reprinted in *Elec. Eng.*, Oct. 28.—A brief description of what is claimed to be a new and powerful type of electromagnet, intended for supporting great weights. Particular kinds of iron ore were selected for the coke and precautions were taken in its reduction; the magnet was constructed for supporting a weight of 10 tons and was excited by current from 25 boron-carbon cells; they are at present used for researches on diamagnetism and polarization of light; a table of data for some of these magnets is given It appears from the drawing that the U-shaped magnets consist of solenoids with cores passing through them for about half their length; the armature has projecting cores attached to it which fit into the remaining space in the cores, the ends of these pieces being rounded to correspond with the cavities at the ends of the fixed cores; (why these magnets should be better than those of the usual ironclad type, is not apparent.)

Photovoltaic Currents in Photography. LUGGIN. *Zeit. f. Phys. Chem.*, 23, 4; noticed briefly in the *Elec. Eng.*, Oct. 21.—An account of a very lengthy investigation; he finds a close connection between the photovoltaic currents given by the haloids of silver, and the decompositions which give rise to photographs; his investigation is said to throw light on the much debated theories of photographic action by showing that the actions in the negatives and in the prints have their counterparts in photovoltaic phenomena.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Bleaching.—Eng. Mag., Nov.—An abstract of an article from the *Moniteur Industriel*, June 5, describing briefly the Kellner electrode which, as was described before, consists of a sheet of hard rubber with a number of platinum points like the bristles of a brush; solutions containing one per cent. of hypochlorites can be produced. Electric bleaching is said to be decidedly cheaper when hydraulic power costs no more than $25 per horse-power per year; with steam power at $70 there is also an appreciable saving in cost.

Nitrogurets.—El'ty, Oct. 27.—A reprint of the translation which was noticed in the *Digest*, Oct. 16.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Optical Study of Alternating Currents. Abraham and Buisson. *Comptes Rendus*, 125, p. 92; noticed briefly in the *Proc. Lond. Phys. Soc.*, Oct.—They describe a method for plotting the strength of the field at each part of an alternation; the rotation in the plane of polarization of light produced by the alternating current at any particular part of the alternation is balanced by the opposed rotation caused by an adjustable continuous current; the light is allowed to flash only at the instant when the current is in the predetermined phase, and for this purpose a spark from a secondary coil is used, the primary being in circuit with a brush connected to the alternator.

New Determination of the Factor v. Maltby. *Wied. Ann*, 61, p. 553; abstracted in the *Proc. Lond. Phys. Soc.*, Oct.—He made a determination with a new arrangement of a Wheatstone bridge in which the capacities of the two halves of an electrometer serve as two branches, while the others contain a capacity and a resistance respectively; the mean value of the constant in this determination was 3.015, the mean of the best previous results being 3.001.

Electrolytic Resistance Measured with a Constant Current. Malstroem. *Zeit. Phys. Chem.*, 22, p. 331; noticed briefly in the *Proc. Lond. Phys. Soc.*, Oct.—He concludes that by using platinized electrodes of about 11 sq. cm. "area resistances of over 10,000 ohms" can be measured without difficulty and with an accuracy of some tenths of a per cent.; resistances of some hundreds of thousands ohms can be measured without platinized electrodes.

Dielectric Constants. Drude. *Wied. Ann.*, 61, p. 466; noticed briefly in the *Proc. Lond. Phys. Soc.*, Oct.—He describes a modification of the wire-wave method for liquids, which requires only very small quantities; the principle depends on the determining of the effect produced by a small condenser filled with the liquid, on the phase of the wire waves reflected by it.

Determination of Capacity with the Balance. Lang. *Elec. Anz*, Oct. 14.—A long abstract of the article which was noticed in the *Digest*, Oct. 16.

Induction Coil Break. Coulon. *L'Elec.*, Oct. 9.—A reprint of the article which was noticed in the *Digest*, Oct. 23.

Clark Cell. Callendar. Lond. *Elec.*, Oct. 22.—A reply to the recent article of Fisher (see *Digest*, Oct. 9). It is evident that there are certain points in connection with the diffusion lag which require to be still further emphasized; Fisher claims that this lag is of no importance, but this is claimed to be based on a misconception of its nature; if a cell is taken from a room at 15° and then into a warm engine-room at 35°, the error due to the diffusion lag might amount to 15 millivolts; the diffusion lag is a question of weeks and not days or hours, and therefore cannot be rendered negligible by enclosing the cell in a non-conducting case; it is not a question of the time taken by the cell to acquire the temperature, but of that required for the solution to become saturated by the slow process of diffusion; the mass of mercury in a cell, therefore, has no effect on the result; the Muirhead cells do not differ essentially in this respect from others; there is no particular virtue in that globule of mercury, and those cells are not intended for the most accurate work. The "inverted" type of cell is not a dry cell as was assumed by Fisher. One of the chief advantages in the present author's original paper was to reconcile the discrepancies in the various determinations of the temperature change by different observers; he showed that this change is the same for different types of the saturated Clark cell, and that an accuracy of nearly one one-hundredths of a millivolt can be obtained with the temperature correction, provided the determination of the temperature is taken carefully, and that the diffusion of lag is eliminated. In a communication following this Kahle claims that the "inverted" form of cell was devised by him in 1892, and was described and illustrated in a journal at the time.

Electrostatic Voltmeter.—Lond. *Elec.*, Oct. 22.—A brief illustrated description of the latest type of Ayrton and Mather instrument, which has been perfected so as to reduce it to a more practical form of instrument.

Measuring Small Gaseous Pressures. Brush. *Elec. Eng.*, Oct. 28.—A reprint of an A. A. A. S. paper, giving an illustrated description of a modified form of McLeod gauge; "large pressures up to one thousand millionths or more are readily measured with this apparatus;" small pressures may be easily measured, with a probable error of less than a thousandth part of a millionth of the atmospheric pressure.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Central Station in Brussels.—L'Elec., Oct. 16.—Some data concerning this new central station which is at present under construction for 15,000 subscribers.

Telephone Station. Montillot. *L'Elec.*, Oct. 9.—An illustrated description of the Bailleux system, including the transmitter and two receivers.

Wireless Telegraphy.—Lond. *Elec.*, Oct. 22.—In a brief communication by Swinton he calls attention to the fact that in Tesla's book, published in 1894, page 346, a method is described in which one terminal is connected to earth and the other to an isolated body with a large surface, elevated above the earth; this feature is therefore not original with Marconi. In another communication, by Appleyard, he endorses Minchin's claims describing experiments made seven or eight years ago, showing the priority of the use of the collecting wire; also the device of earthing the second terminal.

Electrical Communication with Lightships and Light-vessels.—Lond. *Elec.*, Oct. 22.—A reprint of the fifth and final report of the Royal Commission; much of it is merely of local interest. The commissioners introduced the discontinuous cable now being tried at the Fastnet, where there is every indication of ultimate success; the Sunk system has been improved and made sufficiently strong; they do not feel justified in recommending the connection with any more of the stations until "the ethereal system at present under trial has been fully tested;" different systems are recommended for different conditions.

Curbing. Trimmer. Lond. *Elec.*, Oct. 22.—A brief description of a method which he devised eighteen or nineteen years ago, and which was successfully used at that time; a diagram of the connections is given.

Early Telegraphs.—Lond. *Elec.*, Oct. 22.—An extract from a daily paper describing some very early ideas concerning telegraphy. Le Monnier in 1746 sent a current through an iron wire about 2000 yards long; in the next year Watson sent a current across the Thames River, using the river as a conductor; but it seems that in neither case did the idea of using it for signaling occur to the experimenter; the honor of suggesting this belongs to an unknown Scotchman "C. M.," who in February 1, 1753, published an article on "an expeditious method of conveying intelligence"; he proposed using as many wires as there are letters in the alphabet; one end of the particular wires being connected by it, and the other end would then attract a pith ball exposing the desired printed letter. A similar method was suggested by Lesage in 1765, but it was not published until 1782; Soemmering's suggestion to use a current was made in 1809, but forty years previous to this an Italian named Beccaris showed that electric currents produced magnetism, and in 1804 Mojan showed that needles acquired magnetic polarity when placed in a galvanic current; the date of Oersted's experiment was 1819.

MISCELLANEOUS.

Bicycle Speed Indicator. Meylan. *L'Elec.*, Oct. 9.—An illustrated description of the "Volta" direct reading speed indicator to be attached to bicycles. The construction is very simple and the deflections are exactly proportional to the speed, thus enabling it to be calibrated very easily; a cyclometer is also combined with it. The instrument is based on the Arago disc; two magnets are revolved below a small disc of metal which is capable of revolving and carries a pointer with it; the currents induced in this disc are the cause of the deflection, the revolution of the disc being counterbalanced by a spring; the apparatus is driven from the front wheel either by means of a small belt or a wire driven by gearing.

Efficiency of the Alternating Arc. Burnie. Lond. *Elec.*, Oct. 22.—A long illustrated article describing some extended researches the object of which was to endeavor to find the cause of the variation in the efficiency due to different forms of current curves. It is generally agreed that the flatter wave forms are the best for arc lights; Roessler and Wedding in one test obtained a difference of 50 per cent.; the present author made determinations of the instantaneous and mean energy radiations of the alternating arc; the method and apparatus are described in detail; the measurements were made by the coincidence of a slit in a revolving and in a fixed screen by means of which the light and heat emissions could be measured for any phase of the current with a photometer and a bolometer; the revolving disc was driven by a synchronous motor and was so connected that its position on the motor shaft could be varied step by step while running; the apparatus for doing this is illustrated. Solid and cored carbons were used and the current curve was nearly of a sine form; the directions of the greatest intensities in a given plane were not very different for the light and for the heat, and the subsequent measurements were then taken in the direction of the greatest light intensity. There are two sources of radiation, the arc proper with the two bright surfaces of the carbons, and the remaining portions of the carbons; in the former the electrical energy is transformed into heat whereas no heat is produced at the latter; an experiment was made to test from which of these sources the heat radiation came; from this it follows that the heat radiation came almost exclusively from the parts of the carbon and the arc where the heat was produced; the curves and tables of data of the results of his tests are given; they show that the arc deformed the current curve in a very remarkable manner, as a very pointed current curve was produced from a flat potential difference curve; he explains this by assuming that there is an ohmic resistance and a back E. M. F. in the arc; he also found that the variations of the heat radiation are very much smaller than those of the light radiation, which shows how the light variations are brought about; they result from variations in the temperature and the carbon surfaces and therefore the efficiency of the arc is different at different times in each period being greatest when the light is greatest; the efficiency is therefore greater the higher the temperature and there is an upper limit to the efficiency; the current curve which will maintain a state closely approximating to this for the greatest portion of the period,

will be the best curve form; he discusses this mathematically; his conclusions are that the current should rise rapidly to a maximum in order to destroy the effects of the cooling; and it should then fall to such a value as will maintain this state and remain constant for the remainder of the half period; during those parts of the period when the temperature falls the light intensity falls considerably more than the heat and the efficiency is then reduced; a flat wave form, therefore, gives a greater efficiency than a pointed one.

Experiments with the Alternating Arc. SMITH. Lond. *Elec.*, Oct. 22.—A short article describing experiments with the tracing of the E. M. F. and current curves at the terminals of the arc, using various kinds of carbons; the appliances were simple and could easily be attached to any dynamo; some of the curves are given and a comparison shows how the gas generated from the cores acts in helping the current to start across the air gap after each reversal; no difference of phase between the two curves appears, but the highest points are not always reached at the same time, and therefore there may be considerable difference between the real and the apparent watts.

Electrical Energy Direct from Heat. DEPREZ. *Comptes Rendus*, 15, p. 511; translated in the Lond. *Elec.*, Oct. 22.—A short Academy note in which he calls attention to the fact that iron-nickel alloys are strongly magnetic at a certain temperature, but lose this property at only 50° C. higher; from an equation he concludes that a 30 per cent. nickel alloy would lose its magnetic properties almost entirely at 100° C. and would be strongly magnetic at 50° C.; he then describes a generator based on this, and which appears to be exactly like the pyromagnetic generators which were discussed so extensively a number of years ago; the core of a coil is made of a bundle of these wires, which is placed across the poles of a magnet; by heating and cooling these wires between the limits of 100 and 50° C the lines of force will pass alternately through the core and around it, thus cutting the coil and generating an E. M. F. He promises to show in a future communication how the same principle may be applied "to yield truly practical and economical results."

Iron Ore Milling.—Elec. Eng., Oct. 28; *Elec. Rev.*, Oct. 27.—An article describing the Edison process and plant for concentrating a cheap grade of iron ore; the former journal contains a large number of illustrations showing the machinery and the description is more technical, although in both it is quite general in character. After working nearly eight years Edison believes that this work is now thoroughly developed and that every part of the process is on a practical basis. The magnetic concentration is described only very briefly; it is based on the original well known Edison system in which the pulverized ore is made to fall in front of a magnet, the non-magnetic particles falling perfectly vertically while the magnetic ones are deflected sufficiently to fall on the other side of a partition; the concentration is carried on in a building 100 feet high, the ore being dropped through a long series of magnets; the plant will handle 300 tons of crushed ore per hour; the magnets are said to have a face of about 1 mile; their power increases from the upper one to the lowest, the upper ones being for the purest particles and the lower ones for the less pure, which are then crushed and concentrated again. The ore is of a low grade which was formerly considered useless; it contains an average of 25 per cent. of iron; it is soft and easily crushed; on one property it is claimed that there are 50,000,000 tons of iron; the present plant handles from 1000 to 1500 tons of iron daily and it was developed at the expenditure of about $3,000,000; the apparatus is mostly automatic; it includes a 93-ton steel shovel, the largest ever built; the sand from which the ore is separated has value, as it is very sharp. After the concentration the iron ore is dried, mixed with a binding material and formed into briquettes weighing about a pound; the whole process requires 130 minutes; many of the details of the process are kept secret; this ore is used for Bessemer steel; the other mines for Bessemer ore are quite distant from this part of the country; in the final concentrates the percentage of iron oxide is from 91 to 93.

Air Ships and Liquid Air. TAYLOR. *Elec. Eng.*, Oct. 28.—A short article in the first part of which he calculates the weight of a steel shell be necessary to withstand the air pressure if exhausted, and finds that it would weigh 696 tons, which is over twice the displacement weight; the machinery would require 5300 horsepower to drive it at the rate of 40 miles per hour relatively to the wind; the weight of the machinery would be 29 tons, not including the electrical machinery; such an airship is therefore an impossibility. The second part is on liquefied air; calculations are made showing that the power necessary for liquefying 1 pound of air is 0.2658-hp hour, which amounts to $13 for 4900 pounds instead of 1 cent, as has been claimed for the Linde apparatus; the price per cu.m. would therefore be $5.83 (in a recent article by Linde, which was abstracted in the *Digest*, it was stated by the inventor that one litre—about a quart—of liquid air could be produced with an expenditure of 3 horse-power for one hour, a statement which is quite different from the one above, attributed to Linde).

Experiment of the Electric Arc. BONHAM and ALMERT. *West. Elec.*, Oct. 30.—A brief description of an experiment, the object of which was to determine whether there is a counter E. M. F. or not in the arc. The total heat energy of the arc was measured and compared with the total energy absorbed by the arc, the assumption being that if the two were equal, it would indicate the absence of a counter E. M. F. and the presence of something in the nature of a resistance instead; if there was a great difference it would favor the assumption of a counter E. M. F. The arc was enclosed in a sheet iron box which also enclosed an iron wire resistance through which a separate current could be passed; the arc was first run alone for a number of hours until the temperature of the box no longer increased; the current was then sent through the resistance and was adjusted so that the same constant temperature was reached; the electrical energy in each case was measured and there was a discrepancy of 25 watts out of about 400, which they considered to be an allowable error; they believe that the experiment proves beyond a doubt that the phenomenon of the arc is not due to the counter E. M. F. (Had they used a motor in place of the arc, with a brake attached, they should have gotten about the same results, and it is well known that a motor develops a counter E. M. F.; their experiment, therefore, seems to prove nothing. Moreover the test seems to have been too crude to detect other elements which might be of importance in drawing that conclusion.)

Electrical Work in Philadelphia.—Elec. Eng., Oct. 28.—A brief extract from the annual report of Walker. He recommends the extension of the fire signaling system, as there are at present but 885 boxes while there should be at least 2500, which is about equal to the number in New York or Chicago; no new arc lamps were erected owing to the lack of appropriations; the average price per lamp per night has been reduced to 33.3 cents; there are now 6228 arc lamps for the city lighting. 221,834 feet of conduit were laid during the year; the great bulk of the telegraphic wires have been placed underground; there are 51,200 poles and 6163 miles of overhead wires.

Book Reviews.

EASY LESSONS IN MECHANICAL DRAWING AND MACHINE DESIGNS. By J. G. A. Meyer. Quarto. In 24 parts. Arnold Publishing House, New York. Price, per part, 50 cents.

The aim of the author in producing this work has been to provide for beginners, apprentices and others a series of carefully graduated, progressive, easy and comprehensive lessons, forming a full course of practice and instruction in mechanical drawing and the elements of machine design. The whole has been arranged and written with a view of making the book available for home study and meeting the needs of those who are not in a position to procure the assistance of a teacher. Each part gives several practical examples, and all rules for computation are given in plain language, each one being accompanied by a corresponding formula. Each part is illustrated with working drawings of modern machine tools, engines, etc. The language and drawings are clear and simple, and any one without any previous knowledge of mechanical drawing, but possessing a fair amount of intelligence, can, no doubt, make much progress in the attainment of a knowledge of this useful art by a careful study of these books.

POOR'S MANUAL OF THE RAILROADS OF THE UNITED STATES. New York: H. V. & H. W. Poor. 1400 pages. Price, $7.50.

The thirtieth annual number of Poor's Manual of the Railroads of the United States has been issued for 1897. The department devoted to street railways occupies over 100 pages, and is complete with statements showing the history, mileage, equipment, operations, income, capital accounts, directors and officers, etc., of the street railway systems and traction companies in all the cities having a population of 25,000 or more.

Aluminum Cheaper Than Brass.

On October 15 last the Pittsburg Reduction Company issued a price list materially lowering its ordinary rates for aluminum sheet. By this list it is now possible to obtain aluminum sheet, even in small orders, as cheap as brass sheet, volume for volume, and when large orders are considered, the company gives discounts which reduce the cost of aluminum to less than that of brass. In comparing the price of aluminum sheet with brass sheet, the unit of volume should be considered, and not weight for weight. Thus, on this basis of comparison, a sheet of aluminum about 1-32 of an inch thick will weigh one-half pound to the square foot, whereas a square foot of brass sheet of the same thickness will weigh about 1.6 pounds.

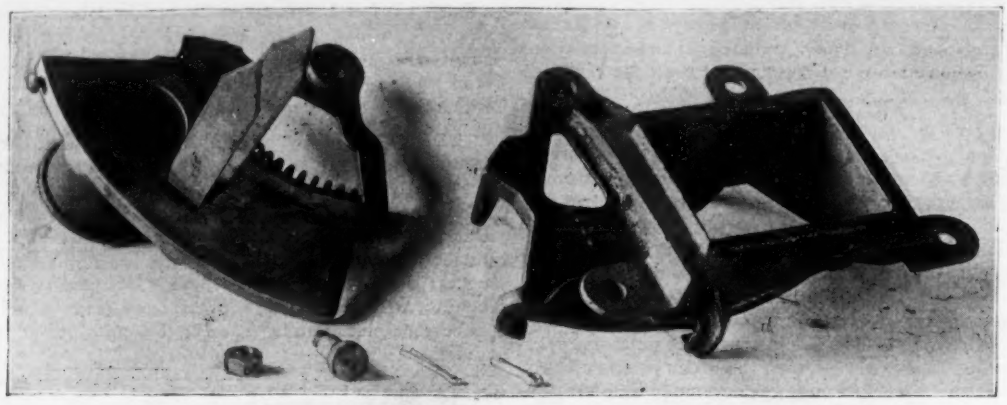
An Effective Sand Box.

The use of sand is recognized by railway men as the most effective and convenient means for temporarily increasing the adhesion and, consequently, the tractive power. The disposition of the sand upon the track, simple as it appears at first, is a problem which presents many serious difficulties. Many of the sand boxes now in use work well under certain conditions, but under others fail to work at all. Usually, the failures happens at a critical moment, when the sand is most needed. Much ingenuity has been expended in the attempt to produce a sand box that will operate with certainty and deliver sand under all conditions.

One of the most effective boxes is that made by the J. G. Brill Company, of Philadelphia. The leading claim made for it by the manufacturer is that of certainty of action—a prime requisite in a device of this kind.

The ordinary valve, the source of endless trouble, has been abolished, the bottom of the box being utilized to take its place. Agitators, fastened to the bottom of the box, are introduced to cut the sand and bring it down, by the simple operation of opening and closing the box. Another feature deserving attention is the attachment of the hose directly to the movable bottom plate, by which it is thoroughly shaken in the act of operating the box. By doing away with the valve and making the whole bottom of the box or hopper open directly into the hose, the annoyance of having the valve stick, when partly closed, is avoided. The box is closed by a spring, but the position of the lever instantly shows whether the flow of sand has been stopped. There is also a positive connection which enables the lever to close the box if the spring should, from any cause, fail to operate.

The shape of the hopper or bottom casting is such that the sand has the least possible distance to travel before reaching the hose. The sand is brought down upon the track by two methods—first, by the action of the agitators, and, second, by shaking the hose.



Working Parts of the Sand Box Dismounted.

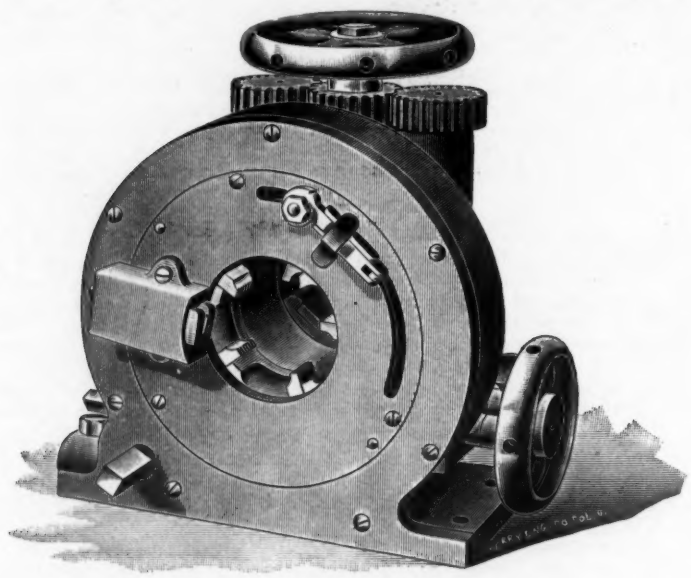
The moving parts and the frame of the box are of malleable iron, and the knives, or agitators, pivots and spring are of steel. The bottom plate is faced with brass to prevent rusting.

In the accompanying illustration the working parts of the sand box, dismounted, are shown.. The boxes can be put in place on a car with the greatest facility by any one.

Portable Hand Pipe Cutting and Threading Machine.

The accompanying illustration represents the "Columbus" portable hand pipe-cutting and threading machine, manufactured by the Columbus Machine Company, Columbus, Ohio. These machines have the latest improved positive quick opening and closing dies, combined universal automatic or hand feed, automatically gauged cutting-off knife and geared self-centering vise. The frame is integral, within which the gearing, die head and vise are journaled in perfect alignment.

Power is applied by rachet lever or extensible crank, or by the simultaneous use of two cranks, the side crank being an important feature for cutting off. Worm-gear engagement of the die head with a frictionally retained hand-wheel shaft gives universal automatic feed or rack and pinion movement at will.



Pipe-Threading Machine.

In operation the pipe is held stationary, the die head traversing the space to be threaded. The chasers have cam movement controlled by a knee-joint lever, adjustably secured to size graduation, by which the chasers are instantly opened and positively closed. Five chasers are used to a set, which insures truer threads than sets of less number, they are readily interchangeable and can be resharpened by grinding. These machines are made in three sizes, for threading pipes from 1 to 8 inches.

A New Potential and Current Indicator.

The Keystone Electrical Instrument Company, Philadelphia, Pa., announces a new line of switchboard potential and current indicators, designed to meet the class of trade requiring accurate and durable instruments at low prices.

The illustration shown herewith gives a general idea of the shape of the instrument and the character of its scale. The instruments are mounted in a tastefully designed case, finished in oxidized copper and well lacquered. The moving parts are mounted in jeweled bearings, the cases are dust-proof, and

Potential Indicator for Switchboard.

the instruments are not affected by external magnetism or changes of temperature.

While the prices at which these instruments will be offered are very low, yet it is claimed that in their design and construction none of the essential features of a thoroughly reliable instrument have been in any way slighted. The instruments are said to be thoroughly reliable, and will no doubt meet with favor in the trade.

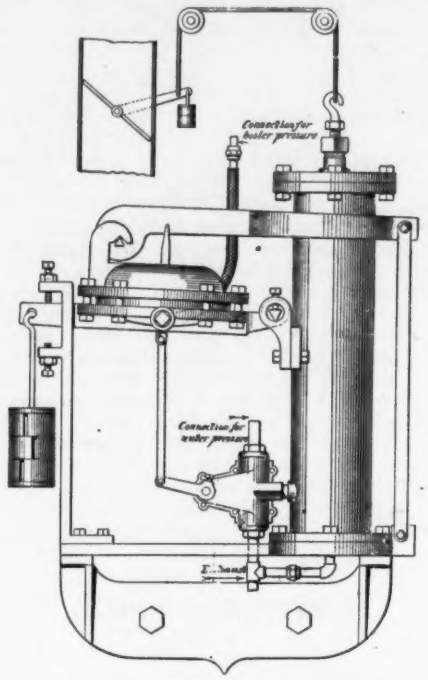
A Damper Regulator.

A damper regulator in a steam-generating plant is becoming more and more recognized as a necessary adjunct of such an establishment. The Climax damper regulator, which is illustrated herewith, is claimed to be the most sensitive and positive regulator now on the market, and Messrs. Kieley & Mueller, 11 West Thirteenth Street, New York City, manufacturers of the device, state that extremely close regulation may be obtained with it.

The valve is operated from the centre of a diaphragm casing. This casing moves up and down, corresponding with the increase and decrease of the steam pressure, conveying thereby to the valve the necessary motion to cause it to let the water into and out of the cylinder, according to its direction of motion. This method of construction imparts to the diaphragm casing itself all the motion required to operate the valve, thus affording much more power for the work of regulation. It is stated that under ordinary condition the diaphragm will last from eight to ten years, without any cost for repairs.

In operation the damper in the flue is closed by the downward motion of

the piston. It is necessary to apply sufficient weight to the damper lever to cause it to open the damper, and at the same time pull up the pison, which it will do immediately after a slight reduction in the steam pressure. This causes a downward movement of the diaphragm casing, and a corresponding movement in the valve, thus closing the inlet port and opening the exhaust port, thereby allowing the water in the cylinder to escape. The weight on the damper lever relieved of the opposing force, opens the damper and at the same time pulls up the piston. In this position the damper will remain until the steam pressure sightly increases. This increased presssure causes an upward motion of the diaphragm casing and a corresponding motion in the valve,



MECHANISM OF DAMPER REGULATOR.

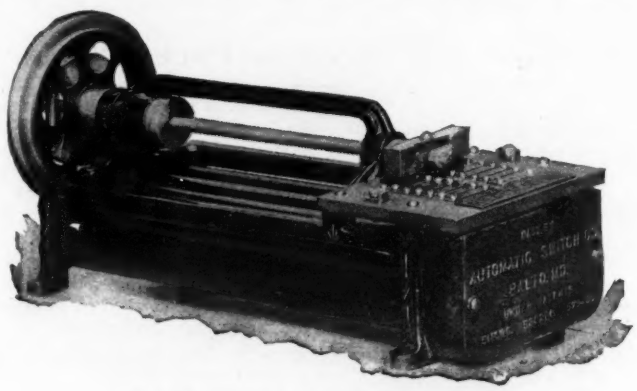
causing the exhaust port to close and the inlet port to open. Water then enters the cylinder and drives the piston down, thus closing the damper. This operation is repeated as often as the pressure falls and increases.

This regulator is provided, when desired, with a graduating attachment, which causes the regulator to gradually open and close the damper. It is claimed that this regulator is sensitive to a one-half-pound variation of steam pressure.

Non-Magnetic Automatic Motor Starter.

The problem of starting motors under load has met with various solutions, but none of them has been so successfully applied as the method of controlling a rheostat in the armature circuit by the movement of the motor itself. A very interesting application of this method is made in the new non-magnetic motor starter manufactured by the Automatic Switch Company, Baltimore, Md., and herewith illustrated.

While the action of this instrument is automatic, and is controlled by the speed of the motor as it accelerates from rest to its full running speed, the



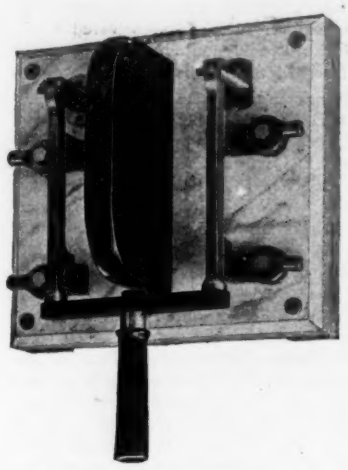
NON-MAGNETIC AUTOMATIC STARTER.

mechanism is so contrived that the motion communicated to the contacts is of a very direct and positive kind. An overload on the motor, after it has attained full speed, has no tendency to replace the starting resistance in circuits, which will be greatly appreciated by users of motors who have had the rheostats burned out by being put in circuit with the armature under a heavy overload.

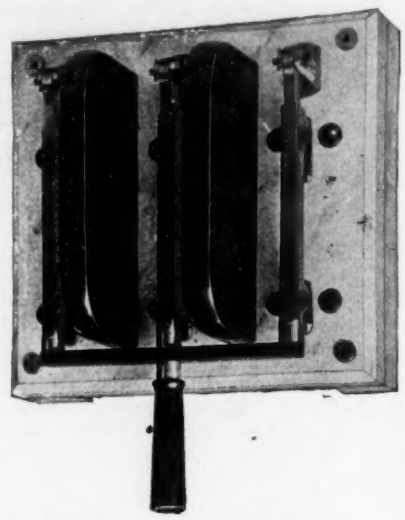
This apparatus is designed for rough and heavy work, and is made without dash-pots, solenoids, magnets, or any sort of latches or trigger. The utmost solidity marks its construction, and it is likely that it will be found as durable as it is simple.

Improved Switches.

Of the switches used by the General Electric Company upon the alternating-current switchboards manufactured at its works in Schenectady, one is the double-break switch, commonly called T-H. This has recently been improved by placing barriers between the blades, making it satisfactory for use on circuits with a potential up to 2300 volts. The other is the so-called "safety" switch, which has the contacts on the back of the panel, while the blades are on the front. When this switch is closed the blades pass through holes in the marble and enter contacts. Barriers are also placed between the blades of this switch. The blades are also insulated from the metal back which holds them. blade, to which the insulated handle is attached, is withdrawn to an angle of 30 degrees before the inner section moves. The inner half of the blade then begins to move, forced from the clip by positive action, and as it leaves the clip it is drawn smartly up to the outer half of the blade by the action of the tension springs. The result is an extremely quick break and a wide gap, over which an arc cannot hold. Switches of this type are made in capacities from



SWITCH WITH BARRIER.

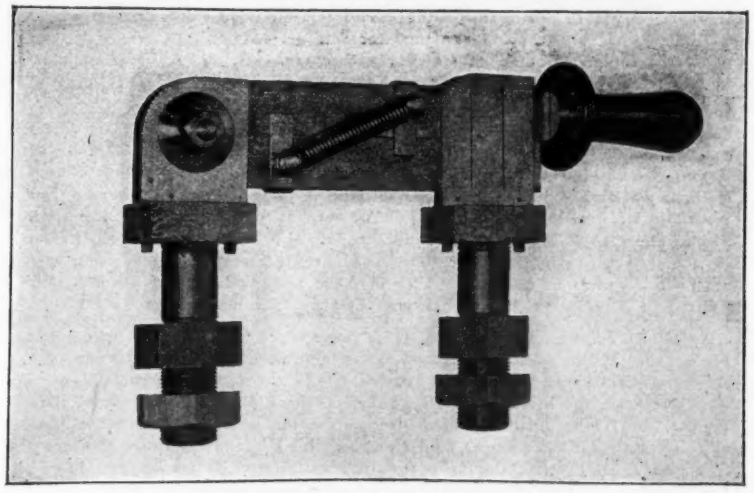


SAFETY SWITCH WITH BARRIERS.

Thus, when closed, no current-carrying part of the switch is exposed, and the chance of shock becomes almost impossible. For higher voltages and inductive loads, specially designed switches are constructed to meet the requirements of the case.

The quick-break switches for use on circuits of nominal 500 volts, also manufactured by this company, are constructed with a view to obtain the greatest accuracy. The switch-blade contact consists of two pieces, laid edge to edge, and connected to a common hinge. They are also connected by a pair of spiral springs, one on each side. Both sections of the blade make connection with the contact clip. In opening the switch, the outer section of the 50 to 5000 amperes at 750 volts, and are constructed for both single and double throw, with or without bases, with either front or back connections, except bases unless on special order.

Single-pole switches, three point, four point, etc., are also manufactured by



QUICK BREAK SWITCH WITHOUT BASE.

the General Electric Company, and are of great convenience in many cases. They swivel at the hinge connection, and may control any reasonable number of circuits. Like the standard switches, they are built with bases, or back connections for switchboards, as desired. The base of the 50-ampere switch is of porcelain; of the larger sizes, slate.

In the accompanying illustrations are shown three styles of switches, two with barriers, and the third, the quick-break switch, without base. In the latter the construction is well represented.

NEWS OF THE WEEK

Financial Intelligence.

THE METROPOLITAN STREET RAILWAY COMPANY'S business in New York is growing at a rapid rate. It is stated that in the first eighteen days of October the earnings increased $1100 a day over those of the corresponding days of last year.

BROOKLYN RAPID TRANSIT showed a little activity last week. The bonds advanced somewhat on investment buying. It is stated that there is an agreement in Brooklyn among the interests identified with passenger transportation in that city that the different opposition surface and elevated roads are now practically under the control of the Brooklyn Rapid Transit Company, but for some reason information in regard to the matter is withheld.

ELECTRICAL STOCK LIST.—The absence of the list of stocks which has for so long formed a feature of THE ELECTRICAL WORLD'S weekly review of the electrical stock market will no doubt be noticed. When the publication of this list was first begun electrical stocks had not reached the stage where they could be classed as gilt-edge investments, and those who were particularly interested in them had practically no other way of obtaining quotations than through the columns of an electrical journal. Times have changed since then. Electrical securities have become universally recognized as desirable investments, and exchanges in the various cities, from New York down, have listed them as part of their regular dealings. The result is that electrical stocks are now quoted in the daily papers, along with the other securities dealt in at the New York and other exchanges. A stock list, therefore, in a weekly class journal is not so necessary as it once was, and the space occupied by the list in THE ELECTRICAL WORLD can be used to advantage for other matter of general interest to the reader. It has been decided, therefore, to discontinue the publication of the stock list. THE ELECTRICAL WORLD will, however, continue to keep its readers informed as heretofore of important happenings in the electrical financial world, and will endeavor, as it always has, to maintain this department as complete as possible, consistent with the space that can be devoted to the subject in such a journal.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK November 4 1897.

NEW YORK VISITORS.—Among the visitors in New York during the week were Mr. George A. McKinlock, president of the Central Electric Company, Chicago, and Mr. William M. Porter, sales agent of the Triumph Electric Company, Cincinnati, Ohio.

A TRIAL TRIP was made on Saturday last over a portion of the newly constructed Fourth Avenue underground trolley road. One of the new electric cars left the Thirty-second Street stables and ran down as far as Broadway and Astor Place. It made the round trip in thirty-five minutes, which was about schedule time. The new car was greeted with cheers by people along the route. It made no stop for passengers. Mr. W. A. Pearson, electrical engineer of the company, acted as the motorman. President Vreeland and other officials of the company were passengers on the car.

EXTENSION OF UNDERGROUND-TROLLEY WORK.—The Metropolitan Street Railway Company has petitioned the State Board of Railroad Commissioners for permission to change to the underground-trolley system its lines on Eighty-sixth Street, from Second Avenue to Madison Avenue; on 106th Street, between Columbus and Amsterdam Avenues; thence to 125th Street, along 125th Street to the Boulevard, up the Boulevard to 130th Street; thence to the North River at the foot of 130th Street. No decision was reached. Application was also made and taken under advisement for a similar change on Ninety-sixth Street, between First and Second Avenues.

A LIVELY TROLLEY-CAR FIGHT took place last Saturday evening at St. George, Staten Island. It was a three-sided affair for the possession of a street for electric-car tracks. The participants in the fight were the village of New Brighton, the Staten Island Electric and the Staten Island Midland Railroads. The Staten Island Electric Company some time ago obtained a franchise from the village trustees, and afterward the Midland Company also got a franchise. The Electric Company promptly put down its tracks, and hostilities resulted. It ended in the Rapid Transit Company, another rival, ripping up the rails on what it alleged was its property, and enjoining the Electric Company from further building. The Midland Company then carried the fight into the courts, and a special commission appointed to hear the matter reported favorably to the Midland Company. On Saturday morning last, in some way or other, the Staten Island Electric Company got the Rapid Transit injunction removed and commenced to lay its rails. Another injunction was issued restraining the Electric Company from carrying on the work, and the superintendent of the electric line and his assistant were arrested for maintaining a nuisance. Hostilities were carried on in a desultory manner, with the result that the railroad officials and Italian laborers were arrested, and the Staten Island Electric Company's track for 500 feet was ripped up. As soon as one gang of Italians was arrested another was ready to take its place, and about every five minutes a squad of a dozen of the laborers was arraigned before the justice.

THE NEW YORK TRADE SCHOOL.—The evening class for instruction in electrical work at the New York Trade School, First Avenue, Sixty-seventh and Sixty-eighth Streets, this city, is doing good work. There are fifty students in this class, and three evenings each week, Monday, Wednesday and Friday, are devoted to instruction. The term began October 18, 1897, and will end on April 13, 1898. During the final week of the term an examination will be held, and those who pass will receive certificates. The course of instruction is as follows: Bell work, annunciators, fire alarms, batteries and connecting the same; telephones, for both single and metallic circuit; telegraph work, electric light, including low-tension incandescent and arc lighting; high-tension series-arc lighting, and alternating high and low tension; calculating sizes of wires, methods of distribution, connecting dynamos, motors, telephones and switchboards, and the care of the same, and storage batteries. During the course lectures applicable to these various subjects are given by Mr. Ralph McNeill. The instructors of the class are J. W. F. Bowles and Stephen Thomas. For experimental work and instruction the school has a 110-light Edison bipolar dynamo, which is driven by a White & Middleton gas engine. The switchboard was installed by the students themselves. It is equipped with Weston voltmeter and ammeter, two test-circuit switches and one dynamo switch. Mr. H. V. Brill is general manager of the school, which is evidently doing very good work and enabling many young men to obtain a good practical education in the various trades taught, thus better fitting them to earn a livelihood.

SOUTHERN NOTES.

WASHINGTON, D. C., Oct. 30, 1897.

THE CAPITAL TRACTION COMPANY, which is now installing an underground electric system on its lines, has awarded the contract for the engines for its new power house to the Edward P. Allis Company, Milwaukee, Wis. This is the same company that supplied the engines used for the operation of the cable system.

THE UNDERGROUND PIPE QUESTION has been receiving considerable and necessary attention lately, owing to the effects thereon by return trolley currents. Inspector Allen, of the Street Lighting Department, has submitted to the Commissioners a report upon his investigations into this subject. He says that the solution of the problem is very simple. One way of accomplishing the desired end, according to Mr. Allen's idea, is to substitute the double-trolley system, which, he says, can be easily installed and successfully operated. In this connection, Commander Davis, of the Washington Naval Observatory, states that the magnetic observations which have been carried on regularly at this institution for several years past, have been rendered practically useless of late by the electrical disturbances caused by the proximity of the Tenallytown electric railway. Unless some means are perfected to neutralize the pernicious effects of the trolley currents, it will be necessary to either remove the observatory from its present site to a distance of at least 2 miles, or discontinue magnetic observations altogether. This would be a loss to science, Commander Davis states. There are two magnetic observatories on the continent of North America, and they are both suffering from the same trouble. The other is at Toronto, Ont., and it has been rendered practically useless by the disturbing effects of the trolley return currents.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., November 1, 1897.

A NEW ORGANIZATION on the farther side of Niagara Falls is to be known as the Canadian Niagara Power League. It is a matter of concern to Canadians generally that all development of Niagara power is on the American side. In order to enlist public sentiment in the new move there are to be branches of the league in all Canadian towns.

THE NIAGARA FALLS HYDRAULIC POWER & MANUFACTURING COMPANY, which operates the Schoellkopf Canal, has asked for bids for the further extension of its power house at the bottom of the gorge. This contemplates the building of the last part of the structure embraced in he original plan. It will, like the second part, develop 12,000 electric horse-power.

THE NEW TRANSFORMER HOUSE of the Niagara Falls Power Company will be equipped with twelve 500-hp transformers, and is to be finished this month. It is promised that the tunnel will be ready to furnish the required power as soon as the line and the transformer house are ready to receive it. This is sooner than was expected, as it was generally thought that there would be no addition this year to the 1000 horse-power now received.

THE ELY TROLLEY LINE to Niagara Falls reports to the State that it carried more people this year than last, the gain being all in August and September. This being the most popular suburban trolley line here, and claimed to be the only one in the country giving a fifteen-minute service, the statement of the officers is of special interest. They say that suburban roads are pretty nearly a dead weight eight months of the year, and that where they run in part over tracks of city lines they actually do the traffic of their own lines harm, from the fact that people who do not go out of the city flock to these

outside cars and drive long-distance passengers to the steam roads. It is claimed that the Ely road loses 100 passengers a day from this source.

THE BUFFALO, HAMBURG & AURORA ELECTRIC RAILWAY COMPANY is in the agony of obtaining a franchise from the State Railroad Commissioners and the property-holders. When built the line will be Y-shaped, and 19 miles in length outside of Buffalo. The power house is to be near the place of union of the three arms. The manager is Mr. U. L. Upson, who expresses a hope that the power house and bridges can be built before spring.

PITTSBURG NOTES.

PITTSBURG, Pa., Nov. 1, 1897.

BEAVER RIVER WATER POWER TO BE DEVELOPED.—The Beaver River Power Company has begun work upon the building for its power house at Fallston. It is the purpose of the company to develop a large amount of water power in the Beaver River at this point, and to transmit it by electricity to the various towns in the Beaver Valley, where it will be utilized for driving machinery, electric-lighting and electric-heating.

NEW ROAD BETWEEN WILMERDING AND McKEESPORT.—A charter was issued last week at Harrisburg to the East McKeesport Railroad Company, of Allegheny County. The capital stock of the company is $35,000, and its incorporators are W. B. Armstrong, of Pittsburg, president; R. F. Ramsay, J. P. Cavenaugh, Curtis Mitchell, Walter Roe, W. H. Hegerman and T. W. Durker, directors. The route described for the new road begins at the end of Fifth Avenue, McKeesport, and extends eastwardly through Versailles Township and East McKeesport, and ends at the Pennsylvania Railroad station in Wilmerding. The route given shows that the line will be in direct competition with the McKeesport, Duquesne & Wilmerding Railway Company, which operates between the points mentioned. It is claimed that the new company will have a shorter line, and will be able to make better time than is made on the present road. It is understood that this charter has been taken out in the interests of the United Traction syndicate, and the completion of the road will give this organization two lines between Pittsburg and McKeesport, one on each side of the Monongahela River.

CHICAGO NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill. . Nov. 1, 1897.

MR. A. A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, was a visitor in Chicago last week.

TELEPHONES FOR EXPORT.—The Stromberg-Carlson Telephone Manufacturing Company, of this city, has recently shipped to Japan a lot of telephones. This was but one of its recent foreign orders. This company's apparatus is meeting with favor abroad as well as at home, and the company is securing a large export trade.

THE ASSIGNEE of the insolvent Metropolitan Electric Company of this city—the Chicago Title & Trust Company—has given notice that sealed proposals for the purchase of the book accounts and bills receivable of the Metropolitan Company will be received at the office of the assignee, No. 100 Washington Street, this city, at or before 9 A. M., November 9.

MR. J. G. IHMSEN, of the Keystone Telephone Company, Pittsburg, Pa., paid a visit to Chicago last week while on his way West on an extensive business trip. He reports a decided improvement in the telephone business in his section of the country, and says that his company is seriously considering the advisability of increasing the facilities of its present factory.

MILWAUKEE NOTES.

MILWAUKEE, Wis., Nov. 1, 1897.

A LOCAL TELEPHONE COMPANY will be established at Marshfield, Wis., with a capital stock of $5000.

THE LAKE GENEVA ELECTRIC COMPANY, Lake Geneva, Wis., has been incorporated, with a capital stock of $9000.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Oct. 27, 1897.

THE DEXTER GOLD MINING COMPANY will install a General Electric three-phase transmission plant in Tuscarora, Nevada. The contract calls for a generator having a capacity of 100-kw and a 75-hp synchronous motor.

THE KERN RIVER ELECTRICAL DEVELOPMENT COMPANY has advertised for proposals on some rock work near Kernville, Cal. There will be a 100-mile transmission required to supply Los Angeles with electricity. The prospects seem favorable for the construction of the entire system in the not remote future.

THE SAN JOSE (CAL.) POWER COMPANY, C. W. Quilty, president, is still in the field with the idea of installing a $300,000 electric-transmission system to supply San Jose. Promoter Beale, of Los Angeles, made a report upon the proposition, which, it is understood, was favorable. The source of water power is in Calaveras Valley, near Mt. Hamilton, but retaining dams would be required to obtain the 30,000 horse-power which it has been claimed would be available.

AN ELECTRIC-IRRIGATION PLANT has been placed in successful operation by Messrs. William Irving, W. G. Fraser and R. R. Winters, at Arlington Heights, Riverside, Cal. A 20-hp motor drives a No. 7 Quimby screw pump, which raises 40 inches of water from the Gage Canal to the highest part of the land. Current is obtained from the system used by the city of Riverside. The estimated cost of irrigating the 250 acres of land is $2.50 per acre per year.

THE PACIFIC COAST ELECTRICAL TRANSMISSION ASSOCIATION commenced the work of its third session in Sacramento, Cal., October 20. Papers on the subject of "Hydraulics and Water Wheels" were read by W. D. Knight, of Sutter Creek, Cal., and W. Stuart-Smith, of San Francisco. Among the visitors was S. Morton Smith, of New York, who was connected with the construction of the Folsom (Cal.) plant, which was inspected by the members of the association. Heretofore the membership has been limited by the exclusion of persons interested in the manufacture of electrical apparatus, but it is likely that provision will be made to admit those desirous of joining as associate members. After the association has visited the principal electric transmission plants of the State, it will probably hold most of its regular sessions in San Francisco. Robert McF. Doble, San Francisco, is secretary of the organization.

THE YUBA POWER COMPANY.—The corporation that will install the Stanley two-phase transmission plant in Yuba County, Cal., which was briefly mentioned in THE ELECTRICAL WORLD of October 9, will be known as the Yuba Power Company. The projectors are E. R. Colgate, a New York capitalist; E. J. de Sabla, Jr., president of the Nevada County Power Company, and John Martin, of San Francisco. The company has procured the use of the water in the canal of the Brown's Valley irrigation district. The original source of the water supply is the Yuba River. Franchises have been purchased, and contracts will soon be let for pole lines through Yuba County and in the town of Marysville. In Brown's Valley the company has taken contracts to supply the Sperry Flour Company, the Webb Mining Company, and several smaller concerns with current by April 1, 1898. Three 500-hp generators will be driven by water wheels. The Marysville Gas & Electric Company, which charges $3.50 a thousand for gas, has received a liberal offer for its plant from the new company.

AN IMPORTANT ORGANIZATION.—The Finance & Construction Company, which has just been organized in San Francisco, with a capital stock of $500,000, will occupy a new field in the electrical line on the Pacific Coast. A competent engineering staff will examine and report upon the feasibility of electric projects. When satisfied that a proposition is a profitable one they will take steps that will mutually benefit the persons who have water rights or land for sale, and the manufacturing companies who desire to supply electric and hydraulic machinery. Under this system honest and valuable enterprises can attract ample capital without delay, and wildcat schemes will find great difficulty in obtaining credit. A variety of objects are included, but examining large transmission propositions will be the leading feature. Besides acting for clients among property-owners and manufacturers, the new company will, when thought desirable, buy water rights and properties that can be profitably developed and operated. The leading manufacturing companies in electric and hydraulic lines, which are represented on the coast, will co-operate with the new concern. Ample capital will be provided to enable its operations to be carried on according to the grand scale which will be necessitated by the immense hydraulic and mining interests to be developed. The personnel of the corporation includes James A. Lightipe, C. S. Young, George P. Low, C. E. Dutcher, and other well-known electrical men and engineers.

CANADIAN NOTES.

MONTREAL, Que., Oct 28, 1897.

TORONTO, ONT.—It is rumored that a movement is on foot to construct an electric railway from Oshawa to this city.

BRANTFORD, ONT.—There is talk of an electric railway being built between this city and Paris, a distance of 7 miles.

BELLEVILLE, ONT.—It is reported that the Belleville Street Railway has been purchased by an English syndicate who propose to extend it to Tweed.

WOODSTOCK, ONT.—M. A. P. McDonald, of Indianapolis, is endeavoring to form a company of Eastern capitalists to build an electric railway between this city and Ingersoll.

VICTORIA, B. C.—F. S. Barnard, manager of the British Columbia Electric Railway Company, has closed a contract with the Esquimault Water Works Company to build a power house at Goldstream, including Pelton wheels and generators. The power will be transmitted a distance of 12 miles.

HAMILTON, ONT.—A large amount of the stock required in the construction of the Hamilton, Chedoke & Ancaster Street Railway has been subscribed, and it is hoped that the work will commence at an early date. It is reported that President Myles, of the Hamilton, Grimsby & Beamsville Railway, has succeeded in raising the sum of $200,000 to build an electric line from Beamsville to St. Catherine.

General News.

THE TELEGRAPH AND TELEPHONE.

BELLEVILLE, ILL.—The Perry County Telephone Company is seeking a franchise in Du Quoin, Ill.

DAVISON, MICH.—The new State Telephone Company will probably establish an exchange in this place.

JACKSONVILLE, TEX.—A telephone line has been completed to Rusk, and will be extended to Henderson and Nacogdoches.

SYCAMORE, ILL.—The line of the DeKalb County Telephone Company is to be extended at once from Sycamore to Kirkland, via Genoa and Kingston, a distance of 16 miles.

RUSHVILLE, ILL.—A grange telephone line is to be constructed from this place to Littleton, thence to Doddsville. Telephones will be put in farmers' residences along the line.

WELLSBURG, OHIO.—A new telephone company has been organized in this place to form connection with the Phœnix Company. The name of the new concern is the Independent Telephone Company.

MONROE, MICH.—The new State Telephone Company, of Michigan, is arranging to consolidate with the Harrison Telephone Company, of Toledo. It is expected that the deal will be consummated in a few weeks' time. The Toledo system, it is stated, will be entirely rebuilt.

ELECTRIC LIGHT AND POWER.

SOUTH OMAHA, NEB.—The Cudahy Packing Company will build an electric power house and purchase electric machinery.

SALINA, KAN.—The City Council is seriously considering the purchase of the paper-mill property for use as an electric-light plant.

MIDDLETOWN, N. Y.—The controlling interest in the Middletown Gas & Electric Light Company has been sold to Mr. George R. Jackson and associates, of Newark, N. J.

LAGRANGE, MO.—It has been voted to establish an electric-light plant in this place. Bonds to the extent of $6000 will be issued and the work of constructing the plant will be commenced at once.

TRENTON, MICH.—Five business men of Trenton desire to build an electric-light plant for the city. They will make application to the Council for a franchise, and if granted, it is said that they will begin construction at once.

RICHMOND, VA.—The Council Committee on Streets has agreed to report favorably the ordinance granting the Virginia Electric Company, of Baltimore, permission to develop the water power of the James River, and furnish electric light and power.

VANCOUVER, B. C.—The City Council accepted the offer made by the London Company to erect a smelter and refinery here. The company proposes to smelt ores by the electrical process, and will put up extensive works, necessitating an outlay of $750,000 to $1,000,000.

HARTFORD, CONN.—The directors of the Hartford Electric Light Company, at a recent meeting, voted to recommend an increase in the capital stock of the company of $150,000, making it in all $500,000. The new Farmington River power house, it is expected, will be completed by November 9.

DENVER, COL.—The blizzard of October 26 did a great deal of damage in this city and in the eastern half of the State. Hundreds of electric light, telephone and telegraph poles were broken down in this city, and 4000 miles of wire lay in the streets in an entangled mass. Street cars were blocked everywhere. On account of the prostration of the electric-light wires the streets of this city were in darkness. The fall of snow was very heavy, and did much damage to shade trees, awnings, signs, etc., beside carrying down the electric wires and poles. It is stated that over 1000 poles were broken down in this city. The damage to the telephone system is placed at $20,000.

THE ELECTRIC RAILWAY.

BROOKLYN, N. Y.—The Brooklyn Heights Railroad Company contemplates extending its trolley lines through Avenue C, Flatbush, to Bath Beach and Bensonhurst.

WATERFORD, MICH.—A franchise was granted for an electric road by the township board. Congressman S. W. Smith and Joseph Sawyer, of Pontiac, are interested in the road.

SANDUSKY, OHIO.—Thomas Wood, of Sandusky, projector of the Sandusky & Lorain Electric Railway, has obtained right of way for his proposed line from this place to Ruggles.

OSHKOSH, WIS.—The deal which has been pending between the horse-car company and the Citizens' Traction Company has been closed, and the effects of the former concern have been purchased by the latter. The purchase price was $37,000.

NEW CASTLE, PA.—Capitalists of New Castle, Youngstown, Ellwood and Pittsburg will apply for a charter to build an electric railway connecting New Castle and Pittsburg, Pa. The road will run through Ellwood, Beaver Falls, Harmony, Evans City and Zelienople.

NORTHAMPTON, MASS.—The Northampton & Amherst Electric Railway Company, of this place, has petitioned the Selectmen of Amherst and Hadley, Mass., for franchises to build its projected electric road through those towns. The Amherst & Sunderland Electric Railway Company has also petitioned for permission to build over the same route.

AKRON, OHIO.—A petition has been presented for the appointment of a receiver to wind up the affairs of the street railway company and sell the road. The object of the petition is to nullify the work of Mr. Emmett C. Gibson, who effected the consolidation of the Akron Street Railway and the Akron General Electric Companies. It is alleged that the transfer of the street railway company to the street railway and illuminating company was fraudulent.

GALVESTON, TEXAS.—A petition for the appointment of a receiver for the Galveston Street Railway Company has been presented in the United States District Court, in this city. The complaint sets forth that on January 1, 1893, the railway company delivered consolidated mortgage bonds to the value of $1,000,000, payable January 1, 1933, and bearing interest at 5 per cent. At the same time it delivered to the Guarantee Trust Company, of New York, a mortgage deed of trust conveying all its personal and other properties. The petition for the foreclosure of the mortgage deed and the appointment of a receiver was granted. Mr. R. B. Baer, of Houston, was appointed receiver.

LEGAL NOTE.

A SUIT has been entered in the United States Court in New Haven, Conn., against the Hartford & West Hartford Railway Company and others by the Electrical Car Company of America, and the Thomson-Houston Electric Company. The suit is brought to prevent the railway company from using a certain kind of electric controller. The patent involved was granted in 1888 to George H. Condict, who transferred his interest to the Electrical Car Company, which, in turn, assigned the right to make and sell the device to the Thomson-Houston Company. It is alleged that the Hartford & West Hartford Railway Company and other railway companies are infringing on this controller. This is said to be a test case. Mr. Frederick H. Betts, of New York, is counsel for the plaintiffs, and Mitchell, Bartlett & Brownell for the defendants.

PERSONAL NOTE.

MR. NELSON W. PERRY, who has for some years occupied the position of editor of *Electricity*, New York City, resigned that position on October 14 to accept one with Messrs. Westinghouse, Church, Kerr & Co., and the Westinghouse Machine Company. Mr. Perry assumed his new duties on November 1. His office is at 604 Havemeyer Building, New York City.

OBITUARY NOTE.

MR. ERNEST HOWARD ARNOLD died at Mazatlan, Mexico, September 24 last, of yellow fever. He was superintendent of the Mazatlan Gas & Electric Light Company, which position he had filled for nearly a year, having left Chicago October 6, 1896, on his twenty-seventh birthday. He was the second to die in Mazatlan with the fever, the secretary of the company having died two days previous. Mr. Arnold was born in Ashland, Neb., and graduated from Hillsdale College, Mich. He was connected with the Thomson-Houston Company in various capacities on expert work for several years, and afterward became chief electrician for the Southern Hotel, St. Louis, for a period of three years, in which city he reconstructed the St. Louis & East St. Louis Railway after the recent cyc'one. He was the fourth brother of the family of which B. J. Arnold, of Chicago, is the eldest, and the first of the brothers to die.

Trade and Industrial Notes.

MESSRS. McKINLOCK & CAMP, who are disposing of the stock of the Metropolitan Electric Company, Chicago, have on hand a large line of white porcelain tubes, as well as clay tubes in all sizes, which they are furnishing to the trade at bargains.

THE GATE CITY ELECTRIC SUPPLY & CONSTRUCTION COMPANY, Atlanta, Ba., it is reported, has been placed in the hands of a receiver, pending a hearing on the petition of the Partrick & Carter Company, of Philadelphia. Mr. W. J. Heyward was appointed temporary receiver.

THE INDICATOR manufactured by the Buffalo Indicator Company, Buffalo, N. Y., is meeting with an increasing demand. It is stated that this indicator is giving entire satisfaction wherever it is used, and, considering its reliability and the excellent workmanship applied in its construction, it is claimed to be the cheapest device of the kind on the market.

TELEPHONE CATALOGUE.—Messrs. De Veau & Co., 32-34 Frankfort Street, New York City, have just issued the eighth edition of their telephone catalogue, descriptive and illustrative of their telephones and the various electrical supplies handled by the concern. It is pocket size, and will be found convenient for reference by those interested in this line of apparatus.

GAS ENGINES are unquestionably growing in demand and favor among power users. The Dayton Gas Engine & Manufacturing Company, Dayton, Ohio, has abundant evidence of this in the call for its gas engines. It has installed a number of 50-hp gas engines, both for ordinary power purposes and electric-lighting work, which are giving the best of satisfaction. The Standard Lamp Company, Wabash, Ind., has just ordered a gas engine of this size.

MR. R. SCHMIDT, 253 Broadway, New York City, has been appointed sales agent of the Warren Electric & Specialty Company, Warren, Ohio. This company, it is well known, manufactures high-grade incandescent lamps, and is independent of the lamp manufacturers' compact. Mr. Schmidt will keep on hand a stock of lamps, and will be able to guarantee immediate delivery of all orders. Mr. Schmidt is ready to furnish samples to all responsible buyers without charge.

ELECTRIC LIGHT FOR BICYCLES.—The four-cell and the three-cell electric-light outfits for bicycles, manufactured by the Ohio Electric Works, Cleveland, Ohio, are said to give a very satisfactory light. These lights cannot be jolted out, and it is claimed that the beam is projected 200 feet in advance of the wheel. One charge of the battery, it is stated, will give a light for four hours at an exceedingly small cost. The Ohio Electric Works has now ready for distribution its 1898 catalogue, a copy of which can be obtained for the asking.

MOTOR-STARTING APPARATUS.—The Automatic Switch Company, of Baltimore, Md., in a little eight-page pamphlet just issued, illustrates and describes its automatic-motor starter and other apparatus. Besides solenoid automatic-motor starters, this company manufactures non-reversible automatic starters, non-magnetic automatic starters, quick-acting switches for use with the different types of automatic starters, an elevator controller, and a reversing switch to reduce the destructive sparking which is so disastrous to the circuit controlling mechanism of elevators.

A SEVERE TEST OF RAIL BONDS.—Mr. Gustave Fischer, agent of the Government of New South Wales, at present in this country purchasing equipments for the Governmental electric-car systems in Sydney, tells of a thorough test he made of the Edison-Brown plastic rail bond. Mr. Fischer took two joints of the standard 83-pound rail, with fishplates and bonds in place, and immersed one in the harbor of Sydney and the other in dilute sulphuric acid. The joints were left in these positions three months, after which they were examined. The metal showed deep corrosion at every point, except where covered by the plastic alloy. Where so covered there was no action apparent. Satisfied by this condition, Mr. Fischer ordered the use of this rail bond on all the Governmental lines.

STEAM PUMPS AND HYDRAULIC MACHINERY, as manufactured by M. T. Davidson, Brooklyn, N. Y., are described and illustrated in a catalogue just issued. The steam pump is particularly well described in every detail, and illustrations of the machine show at a glance its operation. One page is devoted to illustrations of the component parts of the Davidson pumps, each part being numbered for the purpose of facilitating the ordering of new parts. Among the devices shown in the catalogue are the vertical duplex boiler feed pumps, independent air pumps and jet condensers for stationary and marine engines, automatic exhaust relief valve, combined air and circulating pumps, with surface condenser, vacuum pumps, direct air compressors, etc. At the back of the catalogue a great deal of useful engineering information is given in tabular form. The New York office of Mr. Davidson is at 133 Liberty Street.

THE WALKER COMPANY has two busy shops at Cleveland and New Haven, and a glance through the various departments, from draughting room to assembling shop, shows that many machines of many types are in process of construction, to fill contracts on hand. The largest work in hand consists in building the two 1600-kw direct-connected generators for the Brooklyn Heights Railroad Company. Two 225-kw direct-connected generators are being built for the Meadville Traction Company, Meadville, Pa., and in addition to the generators and the station switchboard this company will use eight double street-car equipments of the Walker 4 A, 25-hp type. Five other railway generators are in process of construction for the Paris tramways, three 200-kw of the belted type and two 300-kw direct connected. In addition to these railway generators the Walker Company is engaged in manufacturing three electrical locomotives for Western copper mines. One of these is for a standard-gauge track, and the other two for a narrow 3-foot gauge. In designing and building narrow-gauge motor units of whatever nature the success of the Walker Company is shown conclusively by the immense number of American and foreign orders for machines of this class filled during the past year. Among the isolated plants to be installed by the Walker Company, and now under way, may be mentioned one at the St. Lawrence State Hospital, near Ogdensburg, N. Y., where the plant will consist of six direct-connected generators, two each of 25, 50 and 75-kw capacity, respectively, beside a very complete switchboard. The R. G. Dun Building, now being erected in New York City, will be lighted by three 100-kw direct-connected Walker generators, and plants are to be placed in the Girard Building, Philadelphia (200-kw direct-current Walker generator), and in the new Wellington Hotel, Milwaukee, where two 150-kw machines will supply the light. Orders for over 125 equipments for European street railways are being filled, among them being one for the Ghent Tramway in Belgium. The Bellaire Steel Company, Bellaire, Ohio, whose power plant consists of two 100 direct-connected Walker generators, is about to more than double its capacity by the addition of a direct-connected 250-kw machine.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

DAILY TRAINS TO COLORADO, UTAH AND CALIFORNIA.—Commencing at 10 P. M., September 12, and every night thereafter at the same hour, the Chicago, Milwaukee & St. Paul Railway train will leave the Union Passenger Station (Canal and Adams Streets, Chicago), with elegantly equipped palace sleeping cars for Denver and other Colorado points, with through connections at Denver for Salt Lake City, Ogden, San Francisco and points in Southern California. The route to Denver is via Omaha and Lincoln, Neb., and is first-class in every respect. All the modern facilities of travel are included in this direct route to Colorado—the Eldorado of the West. The allied lines, composing the route, via., the Chicago, Milwaukee & St. Paul Railway—Chicago to Omaha—and the Rock Island & Pacific—Omaha to Denver and Colorado Springs—have united to make this the most popular route to all points west of the Missouri River. For further details, time tables, etc., address E. F. Richardson, General Agent Passenger Department, C., M. & St. P. Ry., 381 Broadway, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED OCTOBER 26, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

592,244. ELECTRICAL-POWER TRANSMISSION; T. J. Fay, Brooklyn, N. Y. App. filed Feb. 12, 1897. The combination, with a hermetically sealed casing, within which is a machine to be driven, of an electric motor having a rotary member consisting merely of a body of iron, located inside of said casing, and connecting with the machine to be driven and a stationary member upon which the electrical conductors of the motor are wound, located outside of the casing, an unperforated wall of the casing being located between said rotary and stationary members.

592,249. FACE PLATE FOR FLUSH SWITCHES; G. W. Hart, Hartford, Conn. App. filed Nov. 5, 1896. A new article of manufacture, being a face-plate for electric switches and the like, said article comprising a body portion having an orifice therein, the edge of said body portion adjacent to said orifice being recessed, an independently formed cupped-shaped blank corresponding substantially in shape, but of greater dimensions than said orifice, said blank being seated in said recess, the metal of the body portion adjacent to said recess engaging and retaining said cupped-shaped blank.

592,269. ELECTRIC-VIBRATING BELL; H. F. Albright, Elizabeth, N. J. App. filed July 11, 1896. A water-proof case for a vibrating bell or buzzer, said case containing the electromagnet, the spring contact and electrical connections, and being provided with a diaphragm through which movement of the armature is communicated to the contact within the case to interrupt the circuit, said case being provided also with a soft-rubber plug through which the circuit wires are led, and a screw cap or clamp for compressing the rubber of the plug about the wires in combination with the vibrating armature, whereby the case is maintained water-tight, while the armature outside the case is permitted to vibrate.

592,301, 592,302, 592,303, 592,304, 592,305, 592,306, 592,307, 592,308, 592,309, 592,310, 592,311, 592,312, 592,313, 592,314, 592,315, 592,316, 592,317, 592,318, 592,319, 592,320, 592,321, 592,322, 592,323, 592,324, 592,325, 592,326, 592,327, 592,328, 592,329, 592,330, 592,331, 592,332, 592,333, 592,334, 592,335, 592,336, 592,337, 592,338, 592,339, 592,340, 592,341, 592,342, 592,343, 592,344, 592,345, 592,346, 592,347, 592,348, 592,349, 592,350, 592,351, 592,352, 592,353, 592,354, 592,355, 592,356, 592,357, 592,358, 592,359, 592,360, 592,361, 592,362, 592,363, 592,364, 592,365, 592,366, 592,367, 592,368, 592,369, 592,370, 592,371, 592,372, 592,373, 592,374, 592,375, 592,376, 592,377, 592,378, 592,379, 592,380, 592,381, 592,382, 592,383, 592,384, 592,385, 592,386, 592,387, 592,388, 592,389, 592,390, 592,391, 592,392, 592,393, 592,394, 592,395, 592,396, 592,397, 592,398, 592,399, 592,400, 592,401, 592,402, 502,403, 592,404, 592,405, 592,406, 592,407, 592,408, 592,409, 592,410, 592,411, 592,412, 592,413, 592,414, 592,415, 592,416, 592,417, 592,418, 592,419, 592,420, 592,421, 592,422, 592,423, 592,424, 592,425. MULTIPLE SWITCHBOARD; M. G. Kellogg, Chicago, Ill. App. filed during the years 1887-1895. Relating to the construction of multiple switchboards.

592,427. CUT-OUT FOR ELECTRIC-SIGNAL BOXES; L. W. Miller, Rochester, N. Y. App. filed Sept. 29, 1896. The combination, with an electrical-signal box, provided with a door and lock, of a cut-out arranged to be operated by the closure of the door, and a supplemental spring-actuated lock attached to the door and having a movable bolt adapted to prevent the closing of the door until retracted by the key.

592,431. TELEPHONE SWITCHBOARD APPARATUS; F. R. McBerty, Downer's Grove, Ill. App. filed Sept. 25, 1896. The combination, with a telephone line having means for producing signaling current in the line, of a line annunciator connected therewith, a clearing-out annunciator also connected with the line, switch contacts actuated by the clearing-out annunciator in its response, and circuits controlled by the switch adapted to render the line annunciator inoperative.

592,432. CUT-OUT RELAY FOR TELEPHONE SWITCHBOARDS; F. R. McBerty, Downer's Grove, Ill. App. filed March 11, 1897. The combination, with a straight core and the winding thereof, of pole pieces for the core extending at right angles thereto and bending toward each other, an armature between the core and the pole pieces overlapping the pole pieces, a switch sping parallel with the armature outside the pole pieces and a normal resting anvil therefor, and a stud connecting the armature with the switch spring.

592,441. ELECTRIC CABLE; W. R. Paterson, Chicago, Ill. App. filed Aug. 20, 1896. A flat cable, consisting of insulated wires wound spirally about a central metallic ribbon; said metallic ribbon having substantially the rigidity and flexibility of copper.

592,443. AUTOMATIC ELECTRIC-CIRCUIT BREAKER AND CLOSER; E. Pruckner and G. Schindler, Newark, N. J. App. filed Feb. 4, 1897. In a circuit-breaker and closer, the combination of a magnetic coil and a vertically movable and adjustable core, said core being mounted upon a rod which is connected to a lever, and a vertically movable rod having a plug connected thereto and insulated therefrom, and two plates insulated from each other adapted for engagement with the said plug, whereby they may be brought into electrical connection with each other, and a base plate of insulating material for mounting the said parts.

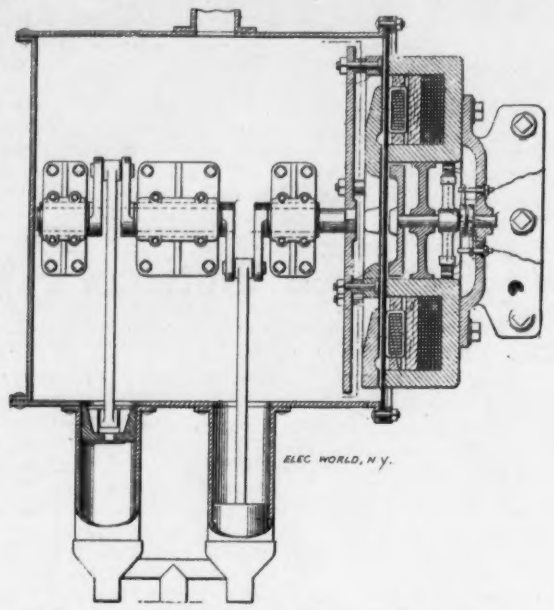
592,452. PILOT LAMP FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed March 11, 1897. The combination, in a circuit, of a source of current a switch controlling the continuity of the circuit, an electromagnet in the circuit and switch contacts actuated thereby, a short circuit of the magnet adapted to be closed by the said switch contacts when the magnet is excited, and means for retarding the movement of the switch-lever controlled by the magnet.

592,463. ELECTRICAL-RESISTANCE DEVICE; E. E. Anthony, Detroit, Mich. App. filed Feb. 23, 1897. An electrical resistance, composed of a concentric series of polygonal resistance coils, supported upon a reel or skeleton frame electrically insulated from each other by insulating material at the corners and air spaces between and a sliding spring jack in frictional adjustable contact between each pair of coils.

592,482. CEILING BLOCK; T. C. Swinnerton, Bridgeport, Conn. App. filed Nov. 2, 1896. The combination of a two-part box, supporting the line wires and lamp wires, consisting of a fixed block, spring-contact clamps secured thereto and projecting without the same to receive the line wires, a cap carrying the lamp wires, said cap detachably secured to said fixed

block by means of a lug or projection detachably secured to one of the said spring-contact clamps, and a spring catch secured to the other of said contact points.

592,494. TELEGRAPH TRANSMITTER FOR OCEAN CABLES; D. Lynch, New York, N. Y. App. filed March 16, 1895. In a system of



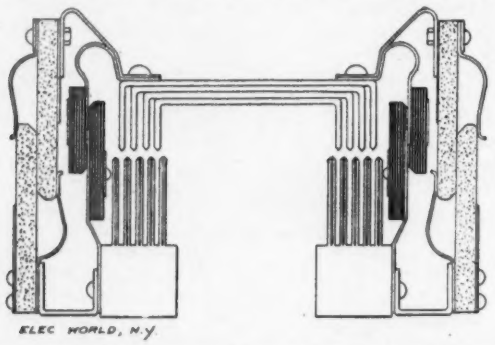
No. 592,244.—Electrical Power Transmission.

telegraphy for ocean cables, the combination with magnets for closing currents in the line in opposite directions, of local batteries in circuit with the magnets, circuit closers for short-circuiting the said magnets, and means for automatically opening and closing said circuit closers at predetermined intervals.

592,497. CONTACT IN SHUNT FOR CIRCUIT BREAKERS; W. M. Scott, Philadelphia, Pa. App. filed May 1, 1897. In a circuit breaker the combination with the main contacts of carbon contacts in shunt for final separation with metal plates yieldingly attached to said carbons adapted to overlap the opposite contacting carbons respectively, and to contact with said carbons upon the other sides from that of the carbon to carbon contact.

592,502. SUPPORT FOR ARMATURE SHAFTS; W. R. Thompson, South Norwalk, Conn. App. filed April 26, 1897. The combination, with the supports of an armature shaft, of a yoke secured thereto, a tubular screw-threaded shaft passing through said yoke, and a supplemental spring operated shaft passing thereinto, and adapted to bear on the armature shaft.

592,503. AUTOMATIC ELECTRIC-ALARM DEVICE; P. V. Vandevelde, Corona, N. Y. App. filed July 26, 1897. The combination, with the frame and sash of a window of an electrical-alarm device, comprising a contact



No. 592,497.—Contact in Shunt for Circuit Breakers.

point mounted in said frame, a spring brush mounted adjacent thereto and adapted to rest normally in contact therewith, said contact point and brush being in electrical connection with the circuit, whereby the circuit is completed when the said brush is in engagement with the said contact point, the brush being held out of contact with the said contact point by the sash weight when the sash is in a closed position.

592,505. ELECTRICAL INSULATOR; W. Barbour, Bar Harbor, Me. App. filed Aug. 28, 1897. In an insulator for line wires, the combination of an inner cylinder of glass or other suitable insulating material, provided with an internal screw, and external projections; with an outer covering of elastic material provided with a groove.

592,524. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; A. Megroz, Buda Pesth, Austria-Hungary. App. filed April 13, 1896. In electric railways, a single insulated main conductor, rocking feeders arranged at suitable distances apart, conductive connections between said feeders and conductor, and circuit closers interposed in said connections and provided each with a stationary and a gravitating contact, said circuit closers carried and rocked by their respective feeders to close and interrupt the feeder circuit, in combination with a traveling current collector, adapted to take current from said feeders, and appliances independent of and traveling with the collector, operating to rock the successive feeders to move the said circuit closers alternately into and out of contact with the collector and thereby alternately close and interrupt the feeder circuit.

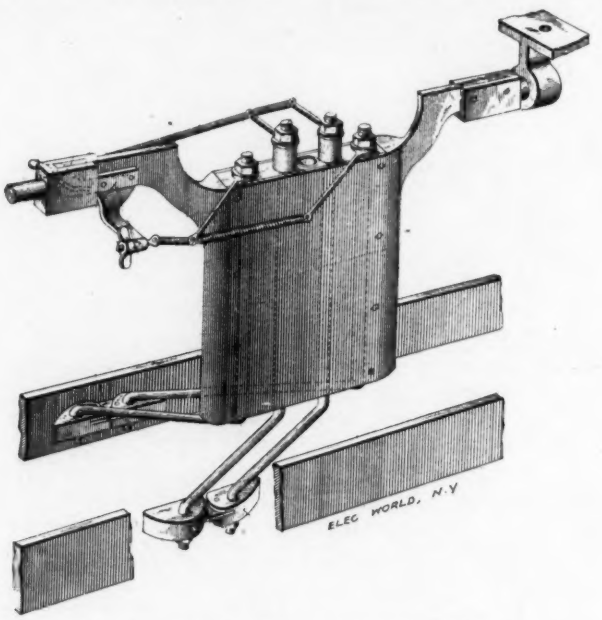
592,528. ELECTRIC RAILWAY; E. C. Crocker, Bridgeport, Conn. App. filed March 1, 1897. The combination, with a railway system, comprising bonded rails and cars capable of traveling thereon, each car carrying a suitable motor and controller box, of a continuous length of insulated rails between the first-mentioned rails laid and secured in position with their abutting ends insulated from each other, magnets carried in pairs at each end of the car and having their course normally depressed with a spring action against said insulated rails, the coils of said magnets being electrically connected respectively with said cores and controller box, the insulated line wire, the insulated solenoids located in the road bed beneath the insulated rails, the armatures immediately beneath the latter and within the field of said magnets and carrying insulated contacts, and connection between the solenoid cores and said armatures, whereby the elevation of the latter will bring the former within the magnetic field of the solenoids, the coils of said solenoids being electrically connected respectively with said contacts and line wire.

592,551. INCANDESCENT ELECTRIC-LIGHT SUPPORT; R. L. Mahon, Duluth, Minn. App. filed July 17, 1896. In an electric-light support, the combination of a rod or arm, a collar rotatably mounted thereon, spring clips carried by said collar, and an incandescent lamp supported in said spring clips.

592,565. JOINT FOR THIRD RAIL FOR ELECTRIC RAILWAYS; P. Haley and P. P. Thomson, Chicago, Ill. App. filed March 22, 1897. In a rail joint, the combination with the adjacent ends of two rails, of plates adapted to close the bottom and sides of the joint, and a good conductor filled in between the ends of the rails and held therein by said plates.

592,596. CONTACT DEVICE FOR ELECTRIC RAILWAYS; E. R. Pommer, New York, N. Y. App. filed Nov. 20, 1888. The combination, with an electric railway car, of a support on the roof of the car, an arm attached to said support, bearings between said arm and support, whereby said arm is permitted to rock on either side of a transverse axis, and also on either side of a longitudinal axis, and a contact device carried by said arm for making an underneath contact with a conductor.

592,600. THERMOMETRIC ELECTRICAL-CIRCUIT CLOSER; G. H. Zeal, London, England. App. filed May 10, 1897. A thermometric electrical-circuit closer, comprising a two-tube thermometer and circuit terminals applied thereto, a mount carrying said thermometer, a fixed support or back-board, to which the mount is pivoted and upon which it is adapted to be turned on its pivot, in a plane parallel with the plane of the tubes,



No. 592,711.—Conduit Railway Trolley.

to vary the heights of the mercury in the tubes and thereby vary the distance between the mercurial column and one of the circuit terminals, whereby the circuit may be closed at varying temperatures.

592,619. ELECTRIC-MOTOR REGULATOR; F. Vidal y Vilaret and D. Belais, New York, N. Y. App. filed May 24, 1897. In combination with an electric motor and in series circuit with the field thereof, a variable resistance, means for automatically and gradually reducing said resistance, and means for automatically breaking said circuit upon a definite increase in current strength thereof.

592,703. ELECTRIC CONDUCTOR; G. Gray, Boston, Mass. App. filed Dec. 4, 1896. A conductor having a continuous core and an outer portion divided by longitudinally and annularly extending grooves, the core being of material harder than that of the outer portions.

592,711. CONDUIT-RAILWAY TROLLEY; W. Luer, Chicago, Ill. App. filed Jan. 4, 1896. The combination, with an electric conductor and vehicle, of a frame secured to the bottom of the vehicle, a series of rods carried by said frame, adjustable contact blocks supported by said rods and means for regulating the contact between said blocks and the conductors.